Topic 0: engineering, environmental, engineers

- Engineering Engineering is a profession that applies mathematics and science to utilize the properties of matter and sources of energy to create useful structures machines products systems and processes (Davis and Cornwell)
- Engineering may be defined as the application under constraints of scientific principles to the planning design construction and operation of structures equipment and systems for the benefit of society (Sincero and Sincero)
- Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study experience and practice is applied with judgment to develop ways to economically utilize the materials and forces of nature for the benefit of human society
- In other words Engineering may be defined as the application under constraints of scientific principles to the planning design construction and operation of structures equipment and systems for the benefit of the society
- If the tasks performed by environmental engineers were examined it would be found that the engineers deal with the structures equipment and systems that are designed to protect and enhance the quality of the environment and to protect and enhance public health and Environmental Engineering Environmental Engineering is defined as the application of engineering principles under constraint to the protection and enhancement of the quality of the environment and to the enhancement and protection of public health and welfare (Sincero and Sincero)
- Environmental Engineering is concerned with engineering problems in the field of environmental sanitation water supplies disposal of or recycle of wastewater and solid wastes along with public health and the elimination of industrial health hazards and the effect of technological advances on the environment (ASCE)
- In general Environmental engineering is focused on Environmental engineers have the responsibility control of water soil and atmospheric pollution and noise pollution To design build and operate water and wastewater treatment plants
- To build and operate solid waste collection transportation and disposal To carry out environmental assessment of projects and products To provide inputs in decision making regarding the environmental issues of development sector and welfare of public To predict the level of pollution and design control mechanisms and products Engineering Project Any engineering project large or small a product being designed or a service to be provided encompasses within its implementation a series of decisions made by engineers

- Sometimes these decisions turn out to be poor and or not appropriate
- A far greater number of decisions however made hundreds of times a day by hundreds of thousands of engineers are correct and improve a lot of the human civilization protect the global environment and enhance the integrity of the profession
- Because so few engineering decisions turn out poorly engineering decision making is a littleknown and rarely discussed process
- Yet when a decision turns out to be wrong the results are often catastrophic
- Often Engineers and Doctors are put on the same footing by the career choosers however a doctor can harm only one person at a time while engineers have potential to harm thousands at a time through incorrectly designed systems
- (Vesilind and Morgan)
- Engineering decisions Engineering decisions could be based on () Technical feasibility () Economic Viability () Socially Acceptable () Environmental friendly Technical feasibility Technical decisions are quantifiable and can be evaluated and checked by other competent professional engineers
- When carrying out technical analysis we often do not have all the information we need to make decisions
- Therefore we must make assumptions
- These assumptions of course must be made using the best available data with a (sometimes liberal) sprinkling of good operated solid waste (garbage) collection program
- They can purchase one of three possible trucks that have the following capacity Truck A m Truck B m Truck C m If the truck is to collect the refuse every day and the truck will have to make only one trip per day to the landfill which truck or trucks will have sufficient capacity
- CostEffectiveness Analysis (Economic Viability) Engineers typically find themselves working for an employer or client who requires that various alternatives for solving an engineering problem be analyzed on the basis of the cost
- For example if a municipal engineer is considering purchasing refuse collection vehicles and finds that the following alternatives to buy the Truck Expensive trucks Higher compaction reduces volume reduces no
- of trips per day Inexpensive trucks lower compaction requires more trips per day How does the engineer know which is less expensive for the community
- Choosing the lowest total cost alternative (given all cost data) would be the most rational decision

- The Environmental Impact of any project is evaluated through different assessment methods
- When engineers work on projects they need to assess the potential impact on the environment
- This involves considering factors such as air and water pollution greenhouse gas emissions habitat destruction and resource depletion
- By conducting environmental assessments engineers can identify and implement solutions that minimize adverse environmental impacts
- Engineers must also consider the social implications of their projects
- This includes assessing the projects impact on local communities public health cultural heritage and overall quality of life
- Social analysis may involve engaging with stakeholders understanding their needs and concerns and incorporating their input into the engineering By considering environmental and social factors engineers can design projects that are not only technically sound but also contribute positively to society and the planet
- This approach aligns with the principles of sustainable development and helps create a more responsible and equitable engineering practice
- Brief Environmental Study (BES) is performed as guided by schedule of EPR
- Few examples of the projects requiring BES are a
- Initial Environmental Examination (IEE) is performed as guided by schedule of EPR
- Few examples of the projects requiring IEE are a
- Environmental Impacts Assessment (EIA) is performed as guided by schedule of EPR
- Few examples of the projects requiring EIA are a
- While carrying out an Environmental Assessment (EA) of a project a noproject scenario is referred against the various alternatives which help to identify the environmental impacts and engineering or social mitigation measures
- Similarly life cycle assessment (LCA) of products is increasingly used in identifying the environmental impacts caused by the manufacturing process and use of the products
- The methods of decision making available to engineers stretch from the most objective (technical) to the most subjective (ethical)
- The inherent method of decision making is the same in all cases
- The problem is first analyzed taken apart and viewed from many perspectives
- When all the numbers are in and the variables are evaluated the information is synthesized into a solution (Vesilind and Morgan)

- Some of the most important under consideration
- Approximations in engineering calculations Engineers are often called on to provide information not in its exact form but as approximations
- For example a KU engineering graduate may be asked by a client such as a mayor of Dhulikhel what it might cost to construct a new wastewater treatment plant for Obviously the engineer cannot in a few minutes conduct a thorough cost estimate
- In the face of such problems the engineer has to draw on whatever information might be available
- There is time enough for more exact calculations later

Topic 5: investment, return, irr, projects, rate

- If a project is planned an estimate of the benefits derived is compared in ratio form to the cost incurred
- Should this ratio be more than the project is clearly worthwhile and the projects with the highest benefitcost ratios should be constructed first because these will provide the greatest returns on the investment
- Internal Rate of Return (IRR) is an indicator to reflect the profit of the projects
- The IRR is the annualized effective compounded return rate or rate of return that makes the net present value of all cash flows (both positive and negative) from a particular investment equal to zero
- In more specific terms the IRR of an investment is the discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment
- Internal rates of return are commonly used to evaluate the desirability of investments or projects
- The higher a projects internal rate of return the more desirable it is to undertake the project
- Assuming all projects require the same amount of upfront investment the project with the highest IRR would be considered the best and undertaken first

Topic 3: plant, beds, project, mld, mw

- IRR values SN Project Name Capacity Project Cost (Arab) IRR () Melamchi Water Supply Project MLD Kaligandaki A Hydroelectric Project MW Raxual Kathmandu Railway (Estimated) km Upper TrishuliB Hydroelectric Project MW Butwal to Mahendranagar TransmissionII kV Environmental friendly and socially acceptable decisions Engineering decisions are also based

on the environmental impacts caused by the project activities which could be in planning implementation or operation phase

- Hospitals from beds up to beds
- Hotels or Resort from beds to beds c Bridges up to m d Municipal or urban roads
- e Up to MLD water supply projects with treatment plant and sewer
- Hospital from to beds Hotel and resort of to beds
- d Upgrading roads from km to km
- e Acquisition of forest area from ha to ha
- f Solar power plant upto MW Hydropower upto MW
- Hospital and hotels above beds
- c Hydropower production above MW
- The stream water has been diverted using a dam and is supplied to a treatment plant
- If the treatment plant can remove of the suspended solids find the concentration of sediments in the effluent of treatment plant
- She would recognize the highly variable nature of land costs construction costs coverage of the municipality as it extends to rural areas as well required treatment efficiency etc
- Yet the mayor wants a preliminary estimate a number and quickly
- For example she might know that the population of the community to be served is approximately
- Next she estimates based on experience that the domestic wastewater flow might be about Liter per capita per day thus requiring a plant of about MLD capacity
- With room for expansion industrial effluents storm inflow and infiltration of groundwater into the sewers she may estimate that MLD capacity may be adequate
- Such domestic wastewater treatment plant she is aware cost about crore ( ) Nepali Rupees per MLD of influent wastewater treated
- She calculates that the plant would cost about crore (Arba)Nepali Rupees
- Giving him herself a cushion hshe could respond by saying about billion Nepali Rupees
- This is exactly the type of information the mayor seeks
- She has no use for anything more accurate because she might be trying to decide whether to ask for a budget of billion or billion
- wastewater
- The plant was established to directly serve a population of X in Gokarna and Chabahil area
- The total project cost of the plant was half billion Nepali Rupees (NRs) in

- Estimate the per capita cost of the project in in (a) NRs MLD of treated wastewater and (b) NRsindividual benefitted

Topic 2: nepal, act, engineers, professional, environmental

- Environmental Laws and Regulation In Nepal Environment Protection Act (EPA) and Environmental Protection Rules (EPR) guides the assessment
- There are three levels of environmental study in Nepal as per project size
- Similarly Solid Waste Management Act This act addresses the management disposal and treatment of solid waste to reduce environmental pollution and promote better waste management practices
- Water Resources Act is an act made to provide for the management of water resources
- Also different policies standards guidelines like guidelines and standards for air pollutants vehicular emissions water and wastewater quality climate change policy are also formulated
- Institution related to engineers in Nepal In Nepal Different institutions and associations are working in this sector
- Nepal Engineering Council (NEC) was formed under the Nepal Engineering Council Act promulgated by then His Majesty the King on BS
- Nepal Engineering Council Rules has also been prepared and approved by then His Majestys Government as per the provision of Clause of the Act
- The first Executive Council was formed on Magh
- The act was amended twice in and BS
- It directs the relationships of Nepalese Engineers with Public Employers and Clients Other Engineers
- The major scope of the NEC is Licensing on the basis of exam Registration of Engineer Recognition of academic institutions
- Produce and monitor the professional code of conduct
- Nepal Engineers Association (NEA) is an independent nonprofit organization of Nepalese Engineers
- It was established in AD (BS)
- NEA during was successful in establishing this very organization
- The organizing of the World Engineering Congress along with the first three national conventions were major milestones in this period
- Nepal Engineers Association office is located at Lalitpur behind UNDP building
- The main objectives to NEA are To promote development of engineering science and

technology in Nepal

- To promote fellowship goodwill and cooperation assistance among the Nepalese engineers and safeguard their rights and interests
- To continuously enhance the highest professional ideals among the members and widen it
- Society of Environmental Engineers Nepal (SEEN) is an institution established by Environmental Engineers of Nepal
- It works for the welfare or Environmental Engineering professionals of Nepal
- Its head office is located at Babarmahal Kathmandu
- SEEN is governed by an executive committee of seven () members elected by the general members of the society
- Some of the major responsibilities of SEEN includes Enhancement of technical and professional competencies of its members
- It works for the protection of the basic professional rights It supports the government and other agencies in the formulation of policies and strategies in related fields
- SEEN is committed to carry out various professional activities that are intended to bring qualitative results to improve the sanitary and environmental conditions of the country
- It aims to work in association with other professional bodies in Nepal and
- Society of Public Health Engineers Nepal (SOPHEN) was registered in Nepal in AD (BS) as an independent professional organization by a group of Nepalese Engineers
- Nepal Environment Society (NES) is an institution that includes all the Environmental professionals of Nepal

Topic 4: , , , ,

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Topic 1: flow, time, volume, mass, rate

- Values Units and Dimensions A quantity is described by values and units
- Units simply describe what the quantity is about
- While measuring and reporting an environmental quantity both of these items need to be mentioned
- For example a river discharge of ms a sand particle of mm snow mass of km in the Himalayas
- In the study of environmental engineering it is quite common to encounter both extremely large quantities and extremely small ones

- The concentration of some toxic substance may be measured in parts per billion while the discharge of a large river may be measured with a larger unit
- on such extreme values it is useful to have a system of prefixes that accompany the units
- Specific symbols are also used to describe these quantities
- Dimension is a unique quantity that describes a basic characteristic of the measurement
- Mass (M) length (L) and time (T) are three fundamental dimensions
- Dimensions are descriptive but not numerical
- They cannot describe how much they simply describe what
- For example the length (L) dimension may be described in units as meters inches or Quantity Prefix Symbol pico p nano n micro μ milli m centi c deci d deca da hecto h kilo k mega M giga G Size and scale of measurement Substances Size μm mm cm m Bacteria Note meter (m) centimeter (cm) millimeter (mm) micrometer (μm) Concentration and density The mass density or density of a material or a solution is defined as its mass per unit volume or Where density V volume In SI system the base unit for density is kgm
- Water in the SI system has a density of kgm which is equal to gcm
- Whereas the concentration of a substance in a solution is defined as mass of solute per unit volume of the solution (including solute and liquid)
- C concentration of A M Mass of material A V Volume of material A In SI system the basic unit for concentration is kgm
- A typical example of the concentration of total dissolved solid in a polluted river like at Bagmati at Teku is mgL or kgm
- Since solutes in solution are often analyzed by weight the terms milligram per liter or microgram per liter is used
- It is often assumed that the substance does not change the density of water
- If such assumption is made and we recall that mL water weighs g then The use of mgL is most common in water applications as the volume of the solution is usually determined as well as the mass of the solute
- The unit ppm is typically used in sludges or sediments
- TCE concentration in mgkg ppm and ppb
- Flow (discharge) rate The flow rate can be expressed as volume of the liquid per unit time
- Q Volumetric flow rate V Volume of the liquid T Time period In SI system the basic unit of volumetric flow rate is ms
- The flow of water is measured in units of volume per unit time

- Commonly used units for flow measurement are liter per second (lps) liter per day (LD) millions liter per day (MLD) cubic meter per second (ms)
- m L MLD Liters per day In engineering processes the flow rate can be either volume flow rate or mass flow rate
- Mass and volumetric flow rates are not independent quantities because the mass (M) of material passing a point in a flow line during unit time is related to the volume (V) of that Q M T (Concentration X Volume) T Concentration X Volumetric flow rate Mass flow rate of waste materials is also called as waste load which is often measured in kgday
- For example the BOD or nutrient loads of a wastewater discharged from a community
- Biological Oxygen demand (BOD) is measured in mgL therefore this concentration should be multiplied by the wastewater flow rate to get the BOD load
- Hydraulic Retention Time One of the most important concepts in treatment processes is retention time also called detention time or even residence time
- It is the time an average particle of the fluid spends in a container through which the fluid flows (which is the time it is exposed to treatment or a reaction)
- An alternate definition is the time it takes to fill the container
- Mathematically Let us assume a tank of volume V with Length L Width W and Height H and Q is the volumetric flow rate
- Let us assume v is the velocity of water flowing through tank
- We know Velocity (v) Distance (L) Time (HRT) Multiplying both side by Cross sectional Area (A) HRT (Since V AL and QAv) The average retention time can be increased by reducing the flow rate Q or increasing the volume V and decreased by doing the opposite
- In SI system the basic unit of retention time is sec
- The tapped flow is lps (liters per second)
- Find the mass flow rate of the sediment in the influent pipe