

merged_topic_0: engineering, sincero, structures, systems, health /
environmental, engineering, public, pollution, profession

- : INTRODUCTION 1.1 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, 2010).

- Definition: 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, 1996).

- 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.

- Definition: 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 welfare.

- 1.2 Environmental Engineering Definition: 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, 1996).

- 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, 1977).

- 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.

- 1.3 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.

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- Environmental Engineering is manifest by sound engineering thought and practice in the solution of problems of environmental sanitation, notably in the provision of safe, palatable (tastes pleasant), and ample public water supplies; the proper disposal of or recycle of wastewater and solid wastes; the adequate drainage of urban and rural areas for proper sanitation; and the control of water, soil, and atmospheric pollution, and the social and environmental impact of these solutions.

- Furthermore it is concerned with engineering problems in the field of public health, the elimination of industrial health hazards, and the provision of adequate sanitation in urban, rural

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construct and operate sewage treatment plants to prevent the pollution of receiving streams.

- 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 One aspect of the profession of environmental engineering is that environmental engineer is engaged in a truly worthwhile mission.

- The environmental engineer is the epitome of the solution as opposed to the problem.

merged_topic_1: investment, return, irr, projects, present / investment, projects, irr, return, rate

- Question: 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 1.0, the project is clearly worthwhile, and the projects with the highest benefit/cost 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.

- Question: Internal rates of return are commonly used to evaluate the desirability of investments or projects.

- The higher a project's internal rate of return, the more desirable it is to undertake the project.

- Assuming all projects require the same amount of up-front investment, the Example: project with the highest IRR would be considered the best and undertaken first.

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- IRR values of some of the projects in Nepal is shown in Table 1.1.

merged_topic_2: engineering, sincero, structures, systems, health / benefit, structures, systems, society, construction

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- "Scientist discover things, Engineers make them work."

merged_topic_3: social, example, engineers, projects / environmental, engineering, public, pollution, profession

- When engineers work on projects, they need to assess the potential impact on the Example: environment.

- By conducting environmental assessments, engineers can identify and implement solutions that minimize adverse environmental impacts.

- Example: Engineers must also consider the social implications of their projects.
- Social analysis may involve engaging with stakeholders,
- understanding their needs and concerns, and incorporating their input into the engineering process.
- Example: 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.
- For example, a KU engineering graduate may be asked by a client, such as
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merged_topic_4: project, hydroelectric, upto, plant, irr / investment, projects, irr, return, rate

- IRR values of some of the projects in Nepal are shown in Table 1.1.
- Project Name Capacity Project Cost (Arab) IRR (%) Melamchi Water Supply Project 170 MLD 32.48 13.50 Kaligandaki A Hydroelectric Project 144 MW 31.70 15.00 Raxual- Kathmandu Railway (Estimated) 135 km Upper Trishuli-3'B' Hydroelectric Project 37 MW 23.60 Butwal to Mahendranagar Transmission-II 132 kV 14.71 1.3.3 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.
- f. Solar power plant upto 5 MW/ Hydropower upto 50 MW.
- The plant was established to directly serve a population of 2 X 10⁵ in Gokarna and Chabahil area.
- The total project cost of the plant was half billion Nepali Rupees (NRs) in 1999.

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file1_topic_5: waste, act, management, solid, guidelines

- To build and operate solid waste collection, transportation and disposal systems 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
- Exercise 1: A town with 4000 residents wants to establish a municipally owned and operated solid waste (garbage) collection program.
- Similarly, Solid Waste Management Act, 2068: This act addresses the management, disposal, and treatment of solid waste to reduce environmental pollution and promote better waste management practices.
- Water Resources Act, 2049 is an act made to provide for the management of water resources. Example:
- Also different policies, standards, guidelines like guidelines and standards for air pollutants, vehicular emissions, water and wastewater quality, climate change policy are also formulated.

- The act was amended twice in 2076 and 2079 B.S.

file1_topic_6: truck, decisions, decision, technical, question

- 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 little-known and rarely Question: discussed process.
- Yet, when a decision turns out to be wrong, the results are often catastrophic.
- 1.4 Engineering decisions Engineering decisions could be based on: (1) Technical feasibility (2) Economic Viability (3) Socially Acceptable (4) Environmental friendly 1.4.1 Technical feasibility Question: 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 judgment.
- They can purchase one of three possible trucks that have the following capacity: Truck A: 8 m³ Truck B: 6 m³ Truck C: 4 m³ If the truck is to collect the refuse every day, and the truck will have to make only one trip Question: per day to the landfill, which truck or trucks will have sufficient capacity?
- 1.4.2 Cost-Effectiveness Analysis (Economic Viability) Question: Engineers, typically find themselves working for an employer or client who requires that Question: various alternatives for solving an engineering problem be analyzed on the basis of the cost.
- Example: 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 Question: 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 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 Question: same in all cases.
- The problem is first analyzed – taken apart and viewed from many Question: perspectives.
- 1.13 Approximations in engineering calculations Engineers are often called on to provide information not in its exact form but as Example: approximations.
- 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.

file1_topic_7: assessment, environmental, guided, schedule, epr

- The Question: Environmental Impact of any project is evaluated through different assessment methods.
- This involves considering factors such as air and water pollution, greenhouse gas emissions, habitat destruction, and resource depletion.
- This includes assessing the project's impact on local communities, public health, cultural heritage, and overall quality of life.
- Brief Environmental Study (BES) is performed as guided by schedule 1 of EPR.
- Initial Environmental Examination (IEE) is performed as guided by schedule 1 of EPR.
- Environmental Impacts Assessment (EIA) is performed as guided by schedule 1 of EPR.
- While carrying out an Environmental Assessment (EA) of a project, a no-project 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.

file1_topic_8: nepal, engineers, council, nepalese, association

- There are three levels of environmental study in Nepal as per project size.
- 1.6 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, 2055 promulgated by then His Majesty the King on B.S.2055/11/27.
- Nepal Engineering Council Rules, 2057 has also been prepared and approved by then His Majesty's Government as per the provision of Clause 37 of the Act.

- The first Executive Council was formed on Magh 2056.
- 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 Authorization of Certificates of academic qualification.
- Recognition of academic institutions.
- Nepal Engineers Association (NEA) is an independent nonprofit organization of Nepalese Engineers.
- It was established in 1968 AD (2024 BS).
- NEA during 1968- 1989 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.
- Society of Environmental Engineers Nepal (SEEN) is an institution established by Environmental Engineers of Nepal.
- It works for the welfare of Environmental Engineering professionals of Nepal.
- Its head office is located at Babarmahal, Kathmandu.
- It aims to work in association with other professional bodies in Nepal and abroad.
- Society of Public Health Engineers, Nepal (SOPHEN) was registered in Nepal in 1990 AD (2047 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.

file1_topic_9: beds, hotels, hospital, resort, roads

- Hospitals from 16 beds up to 25 beds.
- Hotels or Resort from 25 beds to 50 beds c. Bridges up to 250 m. d. Municipal or urban roads.
- Hospital from 25 to 100 beds, Hotel and resort of 51 to 100 beds.
- b. Bridge above 250 m. c. New road construction of up to 25 km.
- d. Upgrading roads from 10 km to 50 km.
- Hospital and hotels above 100 beds.

file1_topic_10: plant, treatment, wastewater, mld, estimate

- e. Up to 5 MLD water supply projects with treatment plant and sewer.
- The stream water has been diverted using a dam and is supplied to a treatment plant.
- If the treatment plant can remove 90 % of the suspended solids, find Question: the concentration of sediments in the effluent of treatment plant?
- a mayor of Dhulikhel, “what it might cost to construct a new wastewater treatment plant for the population of Dhulikhel?” The mayor is not asking for an exact figure but a tentative estimate.
- Next, s/he estimates, based on experience, that the domestic wastewater flow might be about 100 Liter per capita per day, thus requiring a plant of about 3 MLD capacity.
- With room for expansion, industrial effluents, storm inflow and infiltration of groundwater into the sewers, s/he may estimate that 4 MLD capacity may be adequate.
- Such domestic wastewater treatment plant, s/he is aware, cost about 25 crore () Nepali Rupee per MLD of influent wastewater treated.
- Exercise 5: The wastewater treatment plant in Guheshwori receives 0.20 m³/s of wastewater.
- Estimate the per capita cost of the project in 1999 in (a) NRs / MLD of treated wastewater and (b) NRs/individual benefitted.

file1_topic_11: professional, members, seen, responsibilities, monitor

- Produce and monitor the professional code of conduct.
- To continuously enhance the highest professional ideals among the members and widen it.
- SEEN is governed by an executive committee of seven (7) 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.

file1_topic_12: density, concentration, mass, solution, unit

- For example, a river discharge of 500 m³/s, a sand particle of 2 mm, snow mass of 500 km³ 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.
- Substances Bacteria Gravel 39' TV 1.10 Concentration and density Definition: The mass density or density of a material or a solution is defined as its mass per unit volume, or Formula: Where ρ = density Formula: M = mass Formula: V = volume In SI system, the base unit for density is kg/m³.
- Water in the SI system has a density of 1×10^3 kg/m³, which is equal to 1 g/cm³.
- Definition: 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).
- Formula: C_A = concentration of A Formula: M_A = Mass of material A Formula: V_A = Volume of material A In SI system, the basic unit for concentration is kg/m³.
- Question: A typical example of the concentration of total dissolved solid in a polluted river like at Bagmati at Teku is 825 mg/L or 0.825 kg/m³.
- Question: 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 Example: density of water.
- If such assumption is made and we recall that 1 mL water weighs 1 g, then The use of mg/L is most common in water applications as the volume of the solution is Question: usually determined as well as the mass of the solute.
- The unit ppm is typically used in sludges or sediments.
- Question: Exercise 3: 1 kg of soil sample was analyzed and found to contain 5.0 mg TCE.
- What is the Question: TCE concentration in mg/kg, ppm and ppb?
- For example, the BOD or nutrient loads of a wastewater discharged from a community.
- Exercise 4: A stream can have a sediment load of up to 2000 mg/L in the rainy season.

file1_topic_13: flow, time, rate, formula, volume

- 1.11 Flow (discharge) rate The flow rate can be expressed as volume of the liquid per unit time.
- Formula: $QV = V/T$ Where, Formula: QV = Volumetric flow rate Formula: V = Volume of the liquid Formula: T = Time period In SI system, the basic unit of volumetric flow rate is m³/s.
- 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 (m³/s).

- Formula: $1 \text{ m}^3 = 1000 \text{ L}$, $1 \text{ MLD} = 106 \text{ Liters per day}$ 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 material.
- Formula: $Q_M = M / T = (\text{Concentration} \times \text{Volume}) / T$ Formula: = Concentration X Volumetric flow rate Formula: $Q_M = C_A \times Q_V$ Definition: Mass flow rate of waste materials is also called as “waste load” which is often measured in Example: kg/day.
- Biological Oxygen demand (BOD) is measured in mg/L; therefore, this concentration should be multiplied by the wastewater flow rate to get the BOD load.
- 1.12 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, Example: Let us assume, a tank of volume V with Length L, Width W and Height H and Q is the Example: volumetric flow rate.
- Let us assume v is the velocity of water flowing through tank.
- Formula: We know, Velocity (v) = Distance (L) / Time (HRT) Multiplying both side by Cross sectional Area (A), Formula: (Since, $V = A.L$ and $Q = A.v$) The average retention time can be increased by reducing the flow rate Q or increasing the In SI system, the basic unit of retention time is sec.
- Question: The tapped flow is 25 lps (liters per second).
- Find the mass flow rate of the sediment in the influent pipe.

file1_topic_14: billion, costs, mayor, nepali, rupees

- S/he 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!
- Example: For example, s/he might know that the population of the community to be served is approximately 30,000.
- Question: S/he calculates that the plant would cost about 100 crore (1 Arba) Nepali Rupees.
- Giving him/ herself a cushion, h/she could respond by saying, “about 1 billion Nepali Rupees”.

- This is exactly the type of information the mayor seeks.
- S/he has no use for anything more accurate because s/he might be trying to decide whether to ask for a budget of 1 billion or 1.5 billion.

file2_topic_15: professional, professionals, expert, clients, independent

- The professionalism is defined by following seven characteristics: Theorem: Professional decisions are made by means of general principles, theories or propositions Example: that are independent of the particular case under consideration.
- Professional decisions imply knowledge in a specific area in which the person is expert.
- The professional is an expert only in his or her profession and not as expert at everything.
- The professional's relations with his or her clients are objective and independent of particular sentiments about them.
- A professional achieves status and financial reward by accomplishment, not by inherent Example: qualities such as birth order, race, religion, sex or age or by membership in a union.
- A professional's decisions are assumed to be on behalf of the client and to be independent of self-interest.
- The professional relates to a voluntary association of professionals.
- Question: A professional is someone who knows better what is good for clients than do the clients.
- The professional's expertise puts the client into a very vulnerable position.
- This vulnerability has necessitated the development of strong professional codes and ethics, which serve to protect the client.
- Such codes are enforced through colleague peer group.

file2_topic_16: india, new, official, delhi, sewer

- If there were a perfect plant, painting or a road, all future water treatment plants or roads (not the Example: alignment but the structure!)
- Similarly, a sewer can be constructed with a concrete, cast iron, steel, aluminum, plastic or clay materials.
- With correct engineering design procedures, such a sewer would carry the design flow and , thus, would be technically correct (Vesilind and Morgan, 2004).
- Based on the these values, calculation of acceptable levels of pollution is also possible.
- Additional Reading (3) Rubin and Davidson : section a to e (4) Reible : : pp 1-19 References: ASCE (1977) Official Record, Environmental Engineering Division, Statement of Purpose,

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file2_topic_17: operate, build, control, design, counseling

- For example, teaching aid in the a class could be: chalk and a duster, white board marker or a LCD projector.
- - Support the government to develop, adopt and implement policies and strategies for overall development of sanitary and environmental conditions of the country.
- - Provide technical counseling and awareness to public for any critical environmental issues emerged due to natural or human activities.
- To build and operate water treatment plants.
- To build and operate solid waste collection, transportation and disposal systems To plan, design, construct and operate air pollution control equipment.
- To design reservoirs and to control groundwater contamination.
- Our client, in the broadest sense, is the environment itself, and out objective is to preserve and protect our global home, for the sake of our progeny as well as Mother Earth herself.

file2_topic_18: risk, analysis, resources, health, potential

- When life and health enter benefit/cost calculations, the analyses are generally referred as risk/benefit/cost analysis to indicate that people or resources are at risk.
- They have in the past few years become more widely known as simply risk analyses.
- Risk analysis is comprise do risk assessment and risk management.
- The former involves a study and analysis of the potential effect of certain hazards on human health.
- Using statistical information, risk assessment is intended to be a tool for making Definition: informed decisions.
- For example, it has been shown Example: that the life expectancy of people living in a dirty urban atmosphere is considerably shorter than that of people living identical lives but breathing clean air.

- In addition to the potential effect to human health and well being, environmental impacts also include effects on the natural resources or infrastructures providing socio-economic services.
- Risk Question: analysis calculates the potential damage to the health, and environmental impact analysis provides a means for decision making based on long-term effects on resources.

file2_topic_19: sophen, nepal, professional, society, members

- In Nepal, Society of Public Health Engineers (SOPHEN) is an association working the sector.
- Box 1 : Introduction to SOPHEN Society of Public Health Engineers, Nepal (SOPHEN) was registered in Nepal in 1990 AD (2047 BS) as an independent professional organization by a group of Nepalese Engineers.
- SOPHEN is governed by an executive committee of eleven members elected by the general members of the society.
- Some of the major responsibilities of SOPHEN include the enhancement of technical and professional competencies of its members, work for the protection of the basic professional rights and support the government and other agencies in the formulation of policies and strategies in related fields.
- SOPHEN 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 abroad.
- SOPHEN has been recognized by all the sectors of the society as a leading professional body of Nepal.
- Source : SOPHEN (2012)

file2_topic_20: national, technologies, international, level, professional

- Objectives Dissemination of state-of-art technologies to practitioners, policy makers and beneficiaries.
- - Establish professional relationship with similar institutions to national and international level sharing ideas and technologies for mutual benefits and interests.
- - Coordinate with other national and international professional bodies enhancing professional competencies to the implementation of emerging technologies.
- - Building capacities of its members through various research, training and workshop in national and international level.