

ENERGY ENVIRONMENT & SOCIETY (EX 701)

80

Course Objectives:

To understand the various types of energy sources and their environmental impact. To know the role of engineers for creating better and responsible society.

ACEM

CH-1

BY:

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2070/BEX

50 marks

Internal
Ass - 10 marks

External
Ass - 40 marks

ENERGY, ENVIRONMENT AND SOCIETY

EX 701

Lecture : 2

Tutorial : 0

Practical : 0

Year : IV

Part : I

Course Objective:

To understand the various types of energy sources and their environmental impact.
To know the role of engineers for creating better and responsible society.

1. Technology and Development (3 hours)

- 1.1 Introduction to Technology
- 1.2 Appropriate Technology
- 1.3 Role of Appropriate Technology in Transformation of Society
- 1.4 Importance of Technology Transfer
- 1.5 Impact of technology on Society

2. Energy Basics (4 hours)

- 2.1 Importance of Energy in achieving Maslow's hierarchy of Needs, Human Development Index and Energy Consumption
- 2.2 Current Energy Trends, Demand and Supply of Energy in World and Nepal
- 2.3 Introduction to Global warming, Clean Development Mechanism, and Sustainability Issues
- 2.4 Conventional and Non-Conventional/Renewable Energy Sources
- 2.5 Conventional Energy Sources: Fossil fuel, Nuclear Energy

3. Renewable Energy Sources (14 hours)

- 3.1 Solar Energy
 - 3.1.1 Solar radiation
 - 3.1.2 Solar thermal energy
 - 3.1.3 Solar Cell (Photovoltaic Technology)
- 3.2 Hydropower
 - 3.2.1 Water sources and power
 - 3.2.2 Water turbines and hydroelectric plants
 - 3.2.3 Hydro Power Plant Classification (pico, micro, small, medium, large)
- 3.3 Wind Energy
 - 3.3.1 Availability of Wind Energy sources
 - 3.3.2 Wind turbines, wind parks and power control
- 3.4 Geothermal Energy
 - 3.4.1 Sources of Geothermal Energy
 - 3.4.2 Uses of Geothermal Energy
- 3.5 Bio-mass and Bio-energy
 - 3.5.1 Synthetic fu - 3 -om the biomass

3.5.2 Thermo-chemical, physio chemical and bio-chemical conversion

3.5.3 Bio-fuel cells

3.6 Hydrogen Energy and Fuel Cell

3.6.1 Basics of electrochemistry

3.6.2 Polymer membrane electrolyte (PEM) fuel cells

3.6.3 Solid oxide fuel cells (SOFC's)

3.6.4 Hydrogen production and storage

3.6.5 Coal-fired plants and integrated gassifier fuel cell (IGFC) systems

(4 hours)

4. Environmental Impact of Energy sources

4.1 Emission hazard

4.2 Battery hazard

4.3 Nuclear hazard

(3 hours)

5. Energy Storage

5.1 Forms of energy storage

5.2 Hybrid vehicles

5.3 Smart grid systems

5.4 Batteries

5.5 Super-capacitors

(2 hours)

6. Relevant International/national case studies

References:

1. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", Oxford University Press, latest edition
2. Aldo V. da Rosa, "Fundamentals of Renewable Energy Processes"

chapter - 1

Technology and Development

1.1 Introduction to Technology

Technology is the collection of techniques, skills, methods and processes used in the production of goods or services in the accomplishment of objectives such as scientific investigation.

The word technology is derived from the Greek word techne and logia where techne means craft, skill and logia means scientific study.

Technology is the making, modification, usage and knowledge of tools, machines, techniques, crafts, systems, methods of organization in order to solve a problem, improve a pre-existing solution to a problem, achieve a goal and perform a specific function. It may be embodied in various forms such as machinery, equipment, documents process and skills. Technology is man-made.

Features of Technology

- a) It has market value.
- b) It has a cost. (It is not given free)
- c) Its price depends on bargaining strength.
- d) It is new form of currency.
- e) It provides comparative advantage.

Information Technology

It is the application of computers to store, study, retrieve, transmit and manipulate data or information often in the context of a business or other enterprise.

Based on the storage and processing technologies employed, it is possible to distinguish four distinct phases of information technology development. They are:

- a) Pre-mechanical (3000 BC - 1450 AD)
- b) Mechanical (1450 - 1840 AD)
- c) Electromechanical (1840 - 1940 AD)
- d) Electronic (1940 - present).

Construction Technology

Construction Technology is a professional practice of construction engineering which deals with the designing, planning, construction and management of infrastructures such as roads, tunnels, bridges, airports, railroads, factories, buildings, dams, utilities etc.

Communication Technology

Also broadly known as Information and Communications Technology (ICT) is an extended term for Information Technology (IT) which stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals), computers as well as necessary enterprise software, middleware, storage and audio-visual systems which enable to access, store, transmit and manipulate information.

(occurring naturally in particular place)

Indigenous Technology

The information skills and techniques on how a product is to be made without external sponsorship is known as indigenous technology.

Examples:

Bambooware - Furniture, basket etc

Wine making - local fruits

Grinding and milling - watermills (Shiki, Janto)

Handmade paper from Lokta etc

Indigenous technology helps to increase the living-standard of people and in the development of local society.

All the traditional things are not bad and all modern technologies are not always good.

Indigenous technology are sustainable and have no negative impact on society.

envisions → imagine a future possibility.

Sustainable Development

sustainable → able to maintain no damage cause

Sustainable development is defined as a process of meeting human development goals while sustaining the ability of natural systems to continue to provide the natural resources and ecosystem upon which the economy and society depends.

sustainable development is the organizing principle for sustaining finite resources necessary to provide for needs of future generation of life. It is a process that envisions a desirable future state for human societies in which living conditions and resource-use continue to meet human needs without undermining the integrity, stability and beauty of natural biotic systems.

In short, it is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Elements of Sustainable development

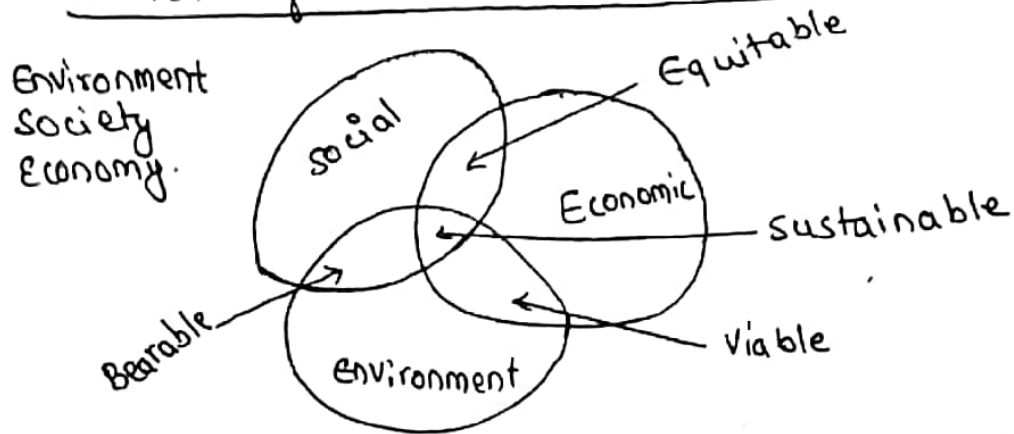


fig: Elements of sustainable development & their relations.

1.2 Appropriate Technology

- Appropriate technology is an ideological movement encompassing technological choice and application that is ~~small scale~~ small-scale, decentralized, labor-intensive, energy efficient, environmentally sound and locally autonomous.
- Appropriate technology has been used to address issues in a wide range of fields. Well-known examples of appropriate technology applications include: bike- and hand-powered water pumps, the universal nut sheller, self-contained solar lamps and streetlights and passive solar building designs.
- Today appropriate technology is often developed using open source principles which have led to open-source appropriate technology (OSAT). OSAT has been proposed as a new model of enabling innovations for sustainable development.
- Appropriate technology is most needed in underdeveloped countries because ~~it~~ underdeveloped countries experience difficulty due to lack of local skill and long delays in supply of spare parts.
- Appropriate technological development is characterized by creative

and sound engineering that recognizes the social, environmental, political, economic as well as technical aspects of a proposed technological solution to a problem facing a society.

Generally appropriate technologies are smaller scale technologies, that are ecologically and socially benign, affordable and often powered by renewable energy.

Characteristics of Appropriate Technology

- a) Must be sustainable.
- b) Manufactured locally.
- c) Affordable by the people.
- d) Meets actual needs of people.
- e) Using renewable energy source.
- f) Installed and maintained by local labour and using expertise.
- g) Environmental friendly.

Criteria for Appropriate Technology.

- a) Maximization of output.
- b) Maximization of the availability of consumption goods.
- c) Maximization of the rate of economic growth.
- d) Reduction of unemployment.
- e) Regional development.
- f) Reduction in balance of payment deficits.
- g) Greater equity in the distribution of income.
- h) Promotion of ~~political~~ development.
- i) Improvement in equality of life.

Factors affecting long-term sustainability.

- a) Manufactured locally.
- b) Utilization of Renewable energy.
- c) Able to install and maintain locally.
- d) Acceptable environmental impact.

Steps to Introduce Appropriate Technology.

- a) Consult and involve community.
- b) Collect current data on mature technologies
- c) Survey local energy sources
- d) Match sources to technologies and needs.
- e) Evaluate technical, social, economic, practical, environmental, political impacts.
- f) Adapt technology to local conditions.

1.3 Role of Appropriate Technology in Transformation of Society.

Society can have various problems such as poverty, population growth, Urbanization, lack of opportunity for women, racial discrimination, health and sanitation problems.

If mentioned problems are tackled, society can be transformed from underdeveloped to developed.

* Building and construction

- Using natural ventilations
- Electrical powered fans at a far lower electrical consumptions as airconditioning systems.
- Using a solar chimney.
- A windcatcher
- A passive down-draft cooltower
- A mudbrick

* Agriculture

- Use of seeds of more growing capacity.
- Organic briquettes (compressed coaldust)

* Water

- Porous ceramic filtration.
- slow-sand filtration.
- chlorine disinfection.
- chemical flocculation

- Irradiation with ultraviolet light (SODIS Method)
- Reverse osmosis filter
- Deep wells with submersible pumps.
- shallow wells
- Rainwater harvesting
- Fog collection
- Air wells

* Sanitation

- Dry toilet
- Arborloo (low-cost type of composting toilet)
- Constructed wetlands.

* Energy generation and Uses.

- photovoltaic (PV) solar panels.
- Solar thermal collector
- Wind power
- Micro hydro and pico hydro
- Human-powered handwheel generators.
- Biogas
- Dry animals dung fuel
- Anaerobic digestion
- Vegetable oils.

* Transportation

- Bicycle
- Bamboo cycle.
- Animal powered vehicles
- whirlwind wheelchair
- zero-emission vehicles.

* Health-Care

- A phase-change incubator
- Birth control
- Jaipur leg.
- Leveraged Freedom chair
- Natural cleaning products.

* Food preparation and storage

- Malian peanut sheller
- Fonio husking machine
- screenless hammer mill
- ISF corn mill
- ISF rice huller
- Solar cookers
- Hot plates
- Rocket stoves
- Eistein refrigerators.
- Thermal mass refrigerators
- pot-in-pot refrigerators.

* Information and Communications

- OLPC XO, Simputer, Asus Eee PC.
- Appropriate Technology Library.
- Wind-up radio
- Grameen Phone
- Mobile telephony
- ~~lowband~~ loband
- Private Internet protocols.
- Wimax
- PABX or local IP-based network.

L.4 Importance of Technology Transfer

* Technology transfer

The transfer of technology can be defined as the transfer of knowledge.

It is the process of transferring technology from the places and ingroups of its origination to wider distribution among more people and places.

It occurs along various axes: among universities, from universities to businesses, from large businesses to smaller ones, from governments to businesses, across borders.

While technology transfer the technology/knowledge has to be used by the end user with minimal input from outside on a long term.

1.5 Impact of technology on Society.

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Impact of technology on Society



- 1) Technology has mechanized agriculture.
- 2) Technology has improved transportation
 - * road
 - * water
 - * air
 - * space
- 3) Technology has improved communications
- 4) Technology has improved education and learning process.

- 1) Resource Depletion
- 2) Increased population
- 3) Increased pollution
- 4) Global warming.
- 5) Disturbance in Bio-cycles.