

CHAPTER 10

WATER RESOURCES AND ENVIRONMENTAL ENGINEERING DISCIPLINE

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COURSE SYNOPSIS

Mechanical Engineering

Introduction to water resources and environmental engineering profession: Definition of water resources and environmental engineering. Specializations/ Options in water resources and environmental engineering. Use of various implements and equipment in water resources and environmental engineering for various operations/process. Prospects and job opportunities in water resources and environmental engineering as a profession. Relevant regulatory bodies and societies in water resources and environmental engineering. The role of water resources and environmental engineers in advancement of humanity.

10.0 INTRODUCTION TO WATER RESOURCES AND ENVIRONMENTAL ENGINEERING DISCIPLINE

10.1 DEFINITION

Water and several environmental problems are among the topmost emerging issues that have local, national and global importance. Water typifies the liquid state of matter and it is one of the most vital natural resources for sustenance of life on earth. It is an abundant natural resource distinctively occupying 75% of the earth surface and equally occupying 50-90% of the weight of living organisms. The main uses of water include application in various domestic, spiritual or cultural, commercial and industrial activities; transportation; agriculture; livelihood; recreation and tourism; energy generation; and firefighting. Water resources are potential sources of water for use and they include surface waters (lakes, rivers, and streams) and groundwater (water beneath the earth's surface). Environment is the sum total of man's surroundings and it includes natural forces and other living things, which provide conditions for development and growth as well as avenues of danger and damage. The natural environment encompasses all living and non-living things occurring naturally on earth. However, when humans modify the natural environment for specific needs, the environment becomes man-made or "built environment". This continuous modification of the natural

environment in addition to expanding global population, presents several challenges to man and the environment.

The world's water resources and environment are continuously witnessing tremendous pressure from all angles; hence there is need for trained engineers with specialty in Water Resources and Environmental Engineering. Though Water Resources and Environmental Engineering have long been two distinct specialist fields in Civil Engineering, the evolution of several water, sanitation and environmental challenges necessitates taking up new skills, capabilities, perspectives and more importantly a "focused" approach to tackle these problems.

Water Resources and Environmental Engineering is the branch of engineering concerned with prediction, planning, development and management of water resources and application of engineering principles to improve and protect the environment. Hence, Water Resources and Environmental Engineers combine knowledge of physical and biological sciences with engineering to solve problems related to unfavorable natural phenomena, population growth, industrialization and urbanization. Such problems include earth quakes, tsunami, tornado, flood, draught, water provision, air and water pollution, sanitation, public health, wastewater, solid wastes, and hazardous wastes management.

10.2 AREAS OF SPECIALIZATION IN WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

Water Resources and Environmental Engineering discipline provides two primary areas of specialization; Water Resources Engineering or Environmental Engineering. However there are numerous options within each area of specialization.

10.2.1 Water Resources Engineering

This is the sub-discipline concerned with planning, developing, managing water, sewage or any other fluid. Research options in Water Resources Engineering include hydraulics, hydrology (surface water, groundwater and marine hydrology), coastal engineering, erosion and flood control, reservoir operation and management, irrigation and drainage, and water supply.

10.2.2 Environmental Engineering

This is an area of specialization concerned with assessing, regulating and managing the effects of human and other activities on both natural and built environment. The overall focus is protection and preservation of the environment.

Research options available in Environmental Engineering include sanitation, air pollution control, air, soil and water remediation, hazardous waste treatment and disposal, wastewater management, solid waste engineering and management, and green engineering.

10.3 SOME EQUIPMENT USED IN WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

The following are some of the equipment used for various operations in Water Resources and Environmental Engineering::

S/No	Equipment	Uses
1.	pH Meter	to determine the alkalinity and acidity of water
2.	Incubator	screening of algae and some other suspended solids in water treatment.
3.	Oven	drying and sterilization of samples
4.	Gas monitor/detector	measuring gaseous air pollutants and particulate matter
5.	Spectrophotometer	testing water quality- qualitative determination of chemical elements in water
6.	Gas Chromatograph	separating a substance or chemicals from a complex sample
7.	Bomb calorimeter	measuring the energy released in a combustion reaction
8.	Hydrokinetics System	to study flow of fluid through closed conduits and open channels
9.	Fluid Friction Apparatus	for determination of fluid friction through pipes
10.	Turbidimeter	measurement of relative clarity of fluids (turbidity)

11.	Flow meter	to measure flow rate or quantity of a gas or liquid in a pipe
12.	Sound level meter	measure sound pressure level/ noise
13.	Capillarity tube	measurement of capillary elevation
14.	Thermometer	measurement of temperature
15.	Rain guage	measure the amount of rainfall or precipitation at a specific place over a particular period of time

10.4 PROSPECTS AND JOB OPPORTUNITIES IN WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

Water Resources and Environmental Engineering encompasses a wide range of disciplines, all of which in some way relate to the provision of the essential services and/or facilities. There is great prospect in pursuing a career in Water Resources and Environmental Engineering. Severe water and environmental problems which need professionalism to subtle gave rise to Water Resources and Environmental Engineering as a distinct discipline. With economic and population growth, there will be a constant demand for Water Resources and Environmental Engineers who can plan and design water and environmental engineering systems.

Water Resources and Environmental Engineering graduates have strong employment opportunities in many sectors of Nigeria and Intergovernmental organizations. In Nigeria, they are employed by intergovernmental, governmental, and non-governmental agencies at local, state and federal levels. Generally employment opportunities for Water Resources and Environmental Engineering graduates are available in the following areas:

10.4.1 Industries/Companies – i.e beverages, water producing, oil and gas, chemical, telecommunication, textile, construction, pharmaceutical, soap & cosmetics, and conglomerates

10.4.2 Federal/State Ministries - i.e. Water Resources & Rural Development, Environment, Agriculture and Natural Resources, Petroleum Resources, Works and Housing , Health and Social Services, Science and Technology.

10.4.3 Agencies & Parastatals – i.e. Nigerian Integrated Water Resources Commission, National Environmental Standards and Regulations Enforcement Agency, River Basin Authorities, Development / Energy Commissions, Water Boards/Corporations, National Maritime Authority, Department of Petroleum Resources, Directorate of Food, Roads & Rural Infrastructures, Department of Fisheries, Federal/State Environmental Protection Agencies, National Agricultural Land Development Authority, National Resources Conservation Council, Standard Organization of Nigeria, and National Emergency Management Agency.

10.4.4 Research Institutes/Institutions – i.e Universities, polytechnics, National Water Resources Institute, Lake Chad Research Institute, Nigeria institute for Oceanography and Marine Research, National Institute for Fresh Water Fisheries Research, International institute for Tropical Agriculture.

10.4.5 International Organizations - i.e. United Nations Environment Programme (UNEP), World Health Organization (WHO), United Nations Development Programme (UNDP), United Nations Children's Fund (UNICEF), Food & Agriculture Organization (FAO), United Nations Education Science and Cultural Organization (UNESCO), Economic Community of West African States (ECOWAS), African Union (AU), Intergovernmental Panel on Climate Change (IPCC), International Bank for Reconstruction and Development (IBRD), WaterAid.

10.4.6 Engagement in service provision - drilling, solid waste and wastewater disposal, clean ups and remediation/reclamation, field studies, project management, construction, advisory and consulting services, supply and installation, dredging, equipment maintenance, environmental audit and impact assessment, and various integrated and customized services.

10.4.7 Manufacturing & production – Sanitary ware/ fixtures/fittings, pipe, conduits manufacturing, small scale and industrial water or beverage production, design and production of water treatment facilities, industrial pumps, valves, mobile toilets, recycling of wastes, air distribution and environmental control systems.

10.4.8 Miscellaneous Employment - i.e. Private firms, consultancy firms, non-Governmental Organizations, part-time supervisory role for sponsored projects, community educators/ instructors/ resource persons, short service course in the

military, appointment into professional/regulatory bodies, boards, and commissions, political appointments.

In all, employers require that a Water Resources and Environmental Engineering practitioner has at least a Bachelor's degree in Water Resources and Environmental Engineering. However, as the engineering graduate progresses in this career, he/she will be required to register with Nigeria Society of Engineers (NSE) and Council for the Regulation of Engineering in Nigeria (COREN). To teach in a Polytechnic, a Bachelor's degree with a minimum of 2nd class lower division is required while to begin a career as an academic in the University, a Bachelor's degree with a minimum of 2nd Class Upper Division is a prerequisite. According to the United States Bureau of Labour Statistics, the employment opportunities for Water Resources and Environmental Engineers are predicted to grow faster than the average growth rate of other occupations in the period through 2014.

10.5 RELEVANT PROFESSIONAL BODIES IN WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

(i) Regulatory Agency

The primary regulatory agency for Water Resources and Environmental Engineering and other engineering disciplines in Nigeria is the Council for the Regulation of Engineering in Nigeria (COREN). The Council was set up by the Decrees 55/70 and 27/92 (now Acts 110).

(ii) Nigeria Society of Engineers (NSE) - The Nigerian Society of Engineers is the umbrella organization for the Engineering profession in Nigeria. The divisions in NSE relevant to Water Resources and Environmental Engineering are (i) Water Division (ii) Environment Division (iii) Marine Engineering & Naval Architecture Division. Categories of membership- Student Member, Graduate Member, Corporate Member, and Fellow.

(iii) Association for Environmental Impact Assessment of Nigeria (AEIAN) - The Association for Environmental Impact Assessment of Nigeria (AEIAN), incorporated on 27th September 2010, is the umbrella body of Nigerian members of the International Association for Impact Assessment (IAIA).

(iv) The Nigerian Meteorological Society (NMetS): NMetS is a forum for scholars, scientists, researchers and stakeholders to promote the ideals of climate science in order to guarantee the safety and well-being of the people, reduce poverty and protect; and improve the environment of Nigeria and the rest of the

world for future generations. Membership levels available for Water Resources and Environmental Engineers are Associate, Corporate and Fellow.

(v) **Nigerian Environmental Society (NES):** The Nigerian Environmental Society is a professional organization which is committed to the protection, development and sustenance of the environment and to the promotion of the profession of Environmental Science and Engineering both in theory and practice.

(vi) **Nigerian Water Supply Association (NWSA):** The Association was set as a professional body with a mission to up-lift man and the environment through improved water supply and sanitation in Nigeria.

(vii) **Water Environment Federation (WEF):** The Water Environment Federation was founded in 1928 and it is a technical and educational organization of individual members and affiliated member associations representing water quality professionals around the world. Membership options for individuals from Nigeria are: (i) WEF Global Professional Membership - Low Income Country and (ii) e-Global Professional Membership.

(viii) **International Solid Wastes Association (ISWA):** The mission of ISWA is to promote and develop sustainable and professional waste management worldwide. National and individual membership is available to Water Resources and Environmental Engineering practitioners.

(ix) **The International Water Association (IWA):** The mission of the association is to serve as a worldwide network for water professionals and to promote standards and best practices in sustainable water management. The association has four member types for Water Resources and Environmental Engineering students/graduates: individual, student, corporate, and governing members.

10.6 ROLE OF WATER RESOURCES AND ENVIRONMENTAL ENGINEERS IN THE ADVANCEMENT OF HUMANITY

Water Resources and Environmental Engineering encompasses a wide range of duties, all of which relate to the environmental protection and provision of the essential services. The critical roles water resources and environmental engineers play in the advancement of humanity are as follows:

- (i) Planning, analysis, design, construction and operation of projects for the control, utilization, and management of water-dependent ecosystems
- (ii) Development and management of systems for storing and providing water for cities, irrigated farms, industrial use, hydroelectric-power generation and other beneficial uses
- (iii) Developing cleaner and more sustainable energy sources and “green” (renewable) materials
- (iv) Management of wastewater and sewage
- (v) Design of sanitation facilities for safe collection and disposal of excreta
- (vi) Collection and disposal of by-products of human activities (wastes) and dispose them in an environmental friendly manner
- (vii) Design projects such as water reclamation facilities, air pollution control systems, and operations that convert waste to energy
- (viii) Addressing the world’s challenges of air, land and water pollution, climate change, and global warming
- (ix) Management of hazardous waste
- (x) Management and design of noise abatement strategies
- (xi) Preventing and controlling flood or soil erosion from damages that may occur
- (xii) Setting of environmental standards and regulation to protect all living things and the natural environment
- (xiii) Cleaning up pollution and locating sites for safe disposal of hazardous wastes
- (xiv) Developing technical guidance materials and regulations, and continuous review of legislations regarding water and the environment
- (xv) Provision of technical assistance to water system operators, design consultants, municipal boards and the general public
- (xvi) Management of assets/ facilities for treatment, supply and distribution of water or any other liquid
- (xvii) Carrying out environmental impact assessment before the execution of a proposed project so as to predetermine the associated environmental or health risks and proffer mitigation methods

- (xviii) Carrying out research to address new challenges and problems that may be caused by population growth, global warming, over-utilization of natural resources, and pollution

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