WASTE GENERATION ASPECTS

FINAL EXAMINATION

TIME ALLOCATION: 3 HOURS

INSTRUCTION TO STUDENTS: ATTEMPT **ALL** QUESTIONS

1. Define the following terms **(20 Marks)**
   i. **Solid waste** - refers to the range of garbage materials arising from animal and human activities that are discarded as unwanted and useless. Solid waste is generated from industrial, residential, and commercial activities in a given area, and may be handled in a variety of ways.
   ii. **Solid waste management** – this is defined as the discipline associated with control of generation, storage, collection, transport or transfer, processing and disposal of solid waste materials in a way that best addresses the range of public health, conservation, economic, aesthetic, engineering, and other environmental considerations.
   iii. **Leachate** – this is liquid discharge of dumps and landfills. It is composed of rotten organic waste, liquid waste, infiltrated rain water and extracts of soluble material.
   iv. **Privatization –** This is the gradual process of disassociating state-owned enterprises or state-provided services from the government control and subsidies and replacing them with market-driven entities
   v. **Medical waste –** This is waste from health posts, clinics, hospitals, pharmacies, medical laboratories, chemists etc., and they pose a serious threat. They could be in form of sharp objects, containing highly infectious organisms, hazardous pharmaceuticals and chemicals and even radio-active waste.
   vi. **Compost –** this is the stable end product derived from the biological degradation of organic material which can vary from dead leaves and roots to kitchen waste and vegetable remains. If well decomposed, the odorless and pathogen-free black-brown mixture can be used as a soil conditioner.

2. Name and explain the Six functional elements of waste management system **(20 Marks)**

   i. **Waste generation**: This includes any activities involved in identifying materials that are no longer usable and are either gathered for systematic disposal or thrown away.
   ii. **Onsite handling, storage, and processing**: This relates to activities at the point of waste generation, which facilitate easier collection. For example, waste bins are placed at sites that generate sufficient waste.
   iii. **Waste collection:** A crucial phase of waste management, this includes activities such as placing waste collection bins, collecting waste from those bins, and accumulating trash in the location where the collection vehicles are emptied.

Although the collection phase involves transportation, this is typically not the main stage of waste transportation.

iv. **Waste transfer and transport:** These are the activities involved in moving waste from the local waste collection locations to the regional waste disposal site in large waste transport vehicles.

v. **Waste processing and recovery**: This refers to the facilities, equipment, and techniques employed to recover reusable or recyclable materials from the waste stream and to improve the effectiveness of other functional elements of waste management.

vi. **Disposal**: The final stage of waste management. It involves the activities aimed at the systematic disposal of waste materials in locations such as landfills or waste-to-energy facilities.

3. State and explain FIVE potential environmental impacts from Solid waste management activities. **(20 Marks)**

i. **Increase in disease transmission or otherwise threaten public health**. – Rotting organic materials pose great public health risks including serving as breeding grounds for disease vectors. Waste handlers and waste pickers are vulnerable and may also become vectors contracting and transmitting disease when human excreta, animal excreta or medical waste are in the waste stream. Risk of poisoning, cancer, birth defects and other ailments are also high.

ii. **Contaminate ground and surface water**. – Municipal solid waste streams can bleed toxic materials and pathogenic organisms into the leachate of dumps and landfills. If the landfill is unlined, this runoff can contaminate ground or surface water depending on the drainage system and the composition of the underlying soils. Many toxic materials, once placed in the general waste stream, can only be removed with expensive advanced technologies which is currently not feasible in Africa.

iii. **Create greenhouse gas emission and other air pollutants** – when organic wastes are disposed off in deep dumps or landfills, they undergo anaerobic degradation and become significant sources of methane, a gas with 21 times the effect of carbon dioxide in trapping heat in the atmosphere. Garbage is often burned in residential areas to reduce the volumes and uncover metals. Burning creates thick smoke that contains carbon monoxide, soot and nitrogen oxide, all of which are hazardous to human health and degrade urban air quality. Combustion of polyvinyl chlorides (PVCs) generates highly carcinogenic dioxins.

iv. **Damage ecosystems** – when solid waste is dumped into rivers or streams, it can alter aquatic habitats and harm native plants and animals. The high nutrient content in organic waste can deplete dissolved oxygen in water bodies, denying oxygen to fish and other aquatic life form. Solids can cause sedimentation and change stream flow and bottom habitat.

v. **Injure people and damage property** – in locations where shanty towns or slums exist near open dumps or near badly designed or operated landfills, land slides or fires can destroy homes and injure or kill residents. The accumulation of waste

along streets may be present physical hazards, clog drains and cause localized flooding.

vi. **Discourages tourism and other business**. – The unpleasant odor and unattractive appearance of piles of uncollected solid waste along streets and in fields, forests and other natural areas can discourage tourism and the establishment and/ or maintenance of businesses.

4. State and explain the following FIVE basic modes of privatization of a waste management body **(10 Marks)**
   i. **Concessions:** A contractual arrangement whereby a private operator is selected and awarded a license to provide specific services over a discrete period of time in return for a negotiated fee. The concession agreement sets out the rights and obligations of the service provider, who generally retains ownership of the principal assets.
   ii. **Management contract –** a legally binding document that places two parties say a service provider and a client under the terms and conditions set for a specific time. The manager has extensive autonomy as set out in the contract.
   iii. **Commercialization –** the process of managing or running (production, distribution, marketing etc.) something principally for financial gain. This method is suitable for managing water supplies.
   iv. **Franchise -** A franchise (or franchising) is a method of distributing products or services involving a franchisor, who establishes the brand's trademark or trade name and a business system, and a franchisee, who pays a royalty and often an initial fee for the right to do business under the franchisor's name and system. Suitable for solid waste management.
   v. **Private enterprise/ entrepreneurship** – this is a method in which the city authority freely allows qualified private firms to compete for service delivery. Under such an arrangement, city councils license, monitor and as needed, sanction the private firms. Private firms bill their customers directly.

5. State FIVE criteria taken in ensuring privatization is successful **(5 Marks)**
   i. Ease of defining outputs
   ii. Efficiency
   iii. Capability
   iv. Competition
   v. Duplication
   vi. Risk
   vii. Accountability
   viii. Costs
   ix. Technology

6. Briefly discus the difference between aerobic and anaerobic decomposition **(10 Marks)**

In an **anaerobic** system there is an absence of gaseous oxygen. In an anaerobic digester, gaseous oxygen is prevented from entering the system through physical containment in sealed tanks. Anaerobes access oxygen from sources other than the surrounding air. The oxygen source for these microorganisms can be the organic material itself or alternatively may be supplied by inorganic oxides from within the input material. When the oxygen source in an anaerobic system is derived from the organic material itself, then the 'intermediate' end products are primarily alcohols, aldehydes, and organic acids together with carbon dioxide. In the presence of specialised methanogens, the intermediates are converted to the 'final' end products of methane, carbon dioxide with trace levels of hydrogen sulphide. In an anaerobic system the majority of the chemical energy contained within the starting material is released by methanogenic bacteria as methane.

In an **aerobic** system, such as composting, the micro-organisms access free, gaseous oxygen directly from the surrounding atmosphere. The end products of an aerobic process are primarily carbon dioxide and water which are the stable, oxidised forms of carbon and hydrogen. If the biodegradable starting material contains nitrogen, phosphorus and sulphur, then the end products may also include their oxidised forms- nitrate, phosphate and sulphate. In an aerobic system the majority of the energy in the starting material is released as heat by their oxidisation into carbon dioxide and water.

7. State FIVE applications of compost **(10 Marks)**

   i. Can be used as soil fertilizer
   ii. Can be used as soil conditioner
   iii. Compost derived from night soil and vegetable matter can be used in fish farms as a nutrient for both the growing algae and as fish feed
   iv. Can be used to increase the porosity of bricks by incorporating it into the bricking material before firing. The organic matter burns during firing leaving the bricks porous.
   v. Compost from horse manure can be used as a substrate for growing mushrooms but compost from urban organic waste cannot be used for this purpose
   vi. Sawdust from industrial sources can be used in its natural condition as mulch.

8. State any FIVE environmental requirements that enhance fish growth in waste-fed ponds **(5 Marks)**

   i. Light
   ii. The right Temperature
   iii. Dissolved oxygen
   iv. Sufficient Ammonia concentration
   v. The right pH levels
   vi. Sufficient Carbon dioxide

vii. Always check the Stocking density
viii. Sufficient Hydrogen sulfide (H_2S)
ix. Limit heavy metals and pesticides
x. Sufficient water supply