SRM INSTITUTE OF SCIENCE & TECHNOLOGY
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# OBJECT-ORIENTED PROGRAMMING AND DESIGN

## Topic-Waste Water Treatment Plant


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# INTRODUCTION

**Wastewater treatment** is a process used to remove contaminants from wastewater and convert it into an effluent that can be returned to the water cycle. Once returned to the water cycle, the effluent creates an acceptable impact on the environment or is reused for various purposes (called water reclamation). The treatment process takes place in a wastewater treatment plant. There are several kinds of wastewater which are treated at the appropriate type of wastewater treatment plant.

Processes commonly used in wastewater treatment include phase separation (such as sedimentation), biological and chemical processes (such as oxidation) or polishing. The main by-product from wastewater treatment plants is a type of sludge that is usually treated in the same or another wastewater treatment plant. Biogas can be another by-product if anaerobic treatment processes are used. Treated wastewater can be reused as reclaimed water. The main purpose of wastewater treatment is for the treated wastewater to be able to be disposed or reused safely. However, before it is treated, the options for disposal or reuse must be considered so the correct treatment process is used on the wastewater.

The term "wastewater treatment" is often used to mean "sewage treatment".

## 1.Types of treatment plants

Wastewater treatment plants may be distinguished by the type of wastewater to be treated. There are numerous processes that can be used to treat wastewater depending on the type and extent of contamination. The treatment steps include physical, chemical and biological treatment processes.

Types of wastewater treatment plants include:

- Sewage treatment plants
- Industrial wastewater treatment plants
- Agricultural wastewater treatment plants
- Leachate treatment plants

### 1.1 Sewage treatment plants

There are a high number of sewage treatment processes to choose from. These can range from decentralized systems (including on-site treatment systems) to large centralized systems involving a network of pipes and pump stations (called sewerage) which convey the sewage to a treatment plant. For cities that have a combined sewer, the sewers will also carry urban runoff (stormwater) to the sewage treatment plant. Sewage treatment often involves two main stages, called primary and secondary treatment, while advanced treatment also incorporates a tertiary treatment stage with polishing processes and nutrient removal. Secondary treatment can reduce organic matter (measured as biological oxygen demand) from sewage, using aerobic or anaerobic biological processes.

Many sewage treatment technologies have been developed, mostly using biological treatment processes. Engineers and decision makers need to consider technical and economic criteria, as well as quantitative and qualitative aspects of each alternative when choosing a suitable technology. Often, the main criteria for selection are: desired effluent quality, expected construction and operating costs, availability of land, energy requirements and sustainability aspects. In developing countries and in rural areas with low population densities, sewage is often treated by various on-site sanitation systems and not conveyed in sewers. These systems include septic tanks connected to drain fields, on-site sewage systems (OSS), vermifilter systems and many more. On the other hand, advanced and relatively expensive sewage treatment plants in cities that can afford them may include tertiary treatment with disinfection and possibly even a fourth treatment stage to remove micropollutants.

## 1.2 Industrial wastewater treatment plants

Industrial wastewater treatment describes the processes used for treating wastewater that is produced by industries as an undesirable by-product. After treatment, the treated industrial wastewater (or effluent) may be reused or released to a sanitary sewer or to a surface water in the environment. Some industrial facilities generate wastewater that can be treated in sewage treatment plants. Most industrial processes, such as petroleum refineries, chemical and petrochemical plants have their own specialized facilities to treat their wastewaters so that the pollutant concentrations in the treated wastewater comply with the regulations regarding disposal of wastewaters into sewers or into rivers, lakes or oceans. This applies to industries that generate wastewater with high concentrations of organic matter (e.g. oil and grease), toxic pollutants (e.g. heavy metals, volatile organic compounds) or nutrients such as ammonia. Some industries install a pre-treatment system to remove some pollutants (e.g., toxic compounds), and then discharge the partially treated wastewater to the municipal sewer system.

## 1.3 Agricultural wastewater treatment plants

Agricultural wastewater treatment is a farm management agenda for controlling pollution from confined animal operations and from surface runoff that may be contaminated by chemicals in fertilizer, pesticides, animal slurry, crop residues or irrigation water. Agricultural wastewater treatment is required for continuous confined animal operations like milk and egg production. It may be performed in plants using mechanized treatment units similar to those used for industrial wastewater. Where land is available for ponds, settling basins and facultative lagoons may have lower operational costs for seasonal use conditions from breeding or harvest cycles. Animal slurries are usually treated by containment in anaerobic lagoons before disposal by spray or trickle application to grassland. Constructed wetlands are sometimes used to facilitate treatment of animal wastes.

## 1.4 Leachate treatment plants

Leachate treatment plants are used to treat leachate from landfills. Treatment options include: biological treatment, mechanical treatment by ultrafiltration, treatment with active carbon filters, electrochemical treatment including electrocoagulation by various proprietary technologies and reverse osmosis membrane filtration using disc tube module technology.

# 2.Unit processes

The unit processes involved in wastewater treatment include physical processes such as settlement or flotation and biological processes such oxidation or anaerobic treatment. Some wastewaters require specialized treatment methods. At the simplest level, treatment of most wastewaters is carried out through separation of solids from liquids, usually by sedimentation. By progressively converting dissolved material into solids, usually a biological floc or biofilm, which is then settled out or separated, an effluent stream of increasing purity is produced.

## 2.1 Phase separation

Phase separation transfers impurities into a non-aqueous phase. Phase separation may occur at intermediate points in a treatment sequence to remove solids generated during oxidation or polishing. Grease and oil may be recovered for fuel or saponification. Solids often require dewatering of sludge in a wastewater treatment plant. Disposal options for dried solids vary with the type and concentration of impurities removed from water.

## Sedimentation

Solids such as stones, grit, and sand may be removed from wastewater by gravity when density differences are sufficient to overcome dispersion by turbulence. This is typically achieved using a grit channel designed to produce an optimum flow rate that allows grit to settle and other less-dense solids to be carried forward to the next treatment stage. Gravity separation of solids is the primary treatment of sewage, where the unit process is called "primary settling tanks" or "primary sedimentation tanks." It is also widely used for the treatment of other types of wastewater. Solids that are denser than water will accumulate at the bottom of quiescent settling basins. More complex clarifiers also have skimmers to simultaneously remove floating grease such as soap scum and solids such as feathers, wood chips, or condoms. Containers like the API oil-water separator are specifically designed to separate non-polar liquids.

## 2.2 Biological and chemical processes

## Oxidation

Oxidation reduces the biochemical oxygen demand of wastewater, and may reduce the toxicity of some impurities. Secondary treatment converts organic compounds into carbon dioxide, water, and biosolids through oxidation and reduction reactions. Chemical oxidation is widely used for disinfection.

## Biochemical oxidation (secondary treatment)

Secondary treatment is the removal of biodegradable organic matter (in solution or suspension) from sewage or similar kinds of wastewater. The aim is to achieve a certain degree of effluent quality in a sewage treatment plant suitable for the intended disposal or reuse option. A "primary treatment" step often precedes secondary treatment, whereby physical phase separation is used to remove settleable solids. During secondary treatment, biological processes are used to remove dissolved and suspended organic matter measured as biochemical oxygen demand (BOD). These processes are performed by microorganisms in a managed aerobic or anaerobic process depending on the treatment technology. Bacteria and protozoa consume biodegradable soluble organic contaminants (e.g. sugars, fats, and organic short-chain carbon molecules from human waste, food waste, soaps and detergent) while reproducing to form cells of biological solids. Secondary treatment is widely used in sewage treatment and is also applicable to many agricultural and industrial wastewaters.

## Chemical oxidation

Advanced oxidation processes are used to remove some persistent organic pollutants and concentrations remaining after biochemical oxidation. Disinfection by chemical oxidation kills bacteria and microbial pathogens by adding hydroxyl radicals such as ozone, chlorine or hypochlorite to wastewater. These hydroxyls radical then break down complex compounds in the organic pollutants into simple compounds such as water, carbon dioxide, and salts.

## Anaerobic treatment

Anaerobic wastewater treatment processes (for example UASB, EGSB) are also widely applied in the treatment of industrial wastewaters and biological sludge.

## 2.3 Polishing

Polishing refers to treatments made in further advanced treatment steps after the above methods (also called "fourth stage" treatment). These treatments may also be used independently for some industrial wastewater. Chemical reduction or pH adjustment minimizes chemical reactivity of wastewater following chemical oxidation. Carbon filtering removes remaining contaminants and impurities by chemical absorption onto activated carbon. Filtration through sand (calcium carbonate) or fabric filters is the most common method used in municipal wastewater treatment.

## 3.References

www.google.co.in

www.wikipedia.com

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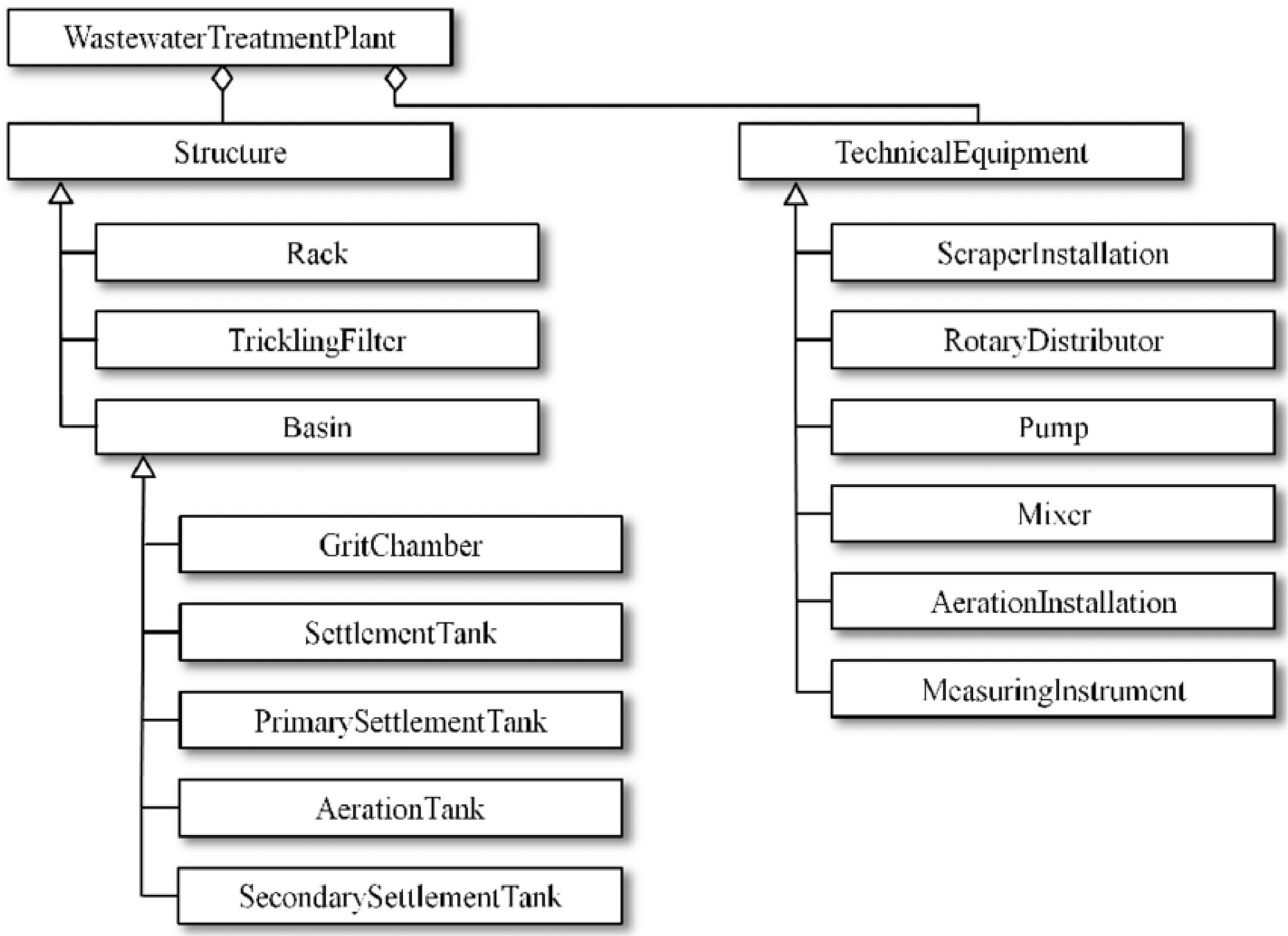
# CLASS DIAGRAM



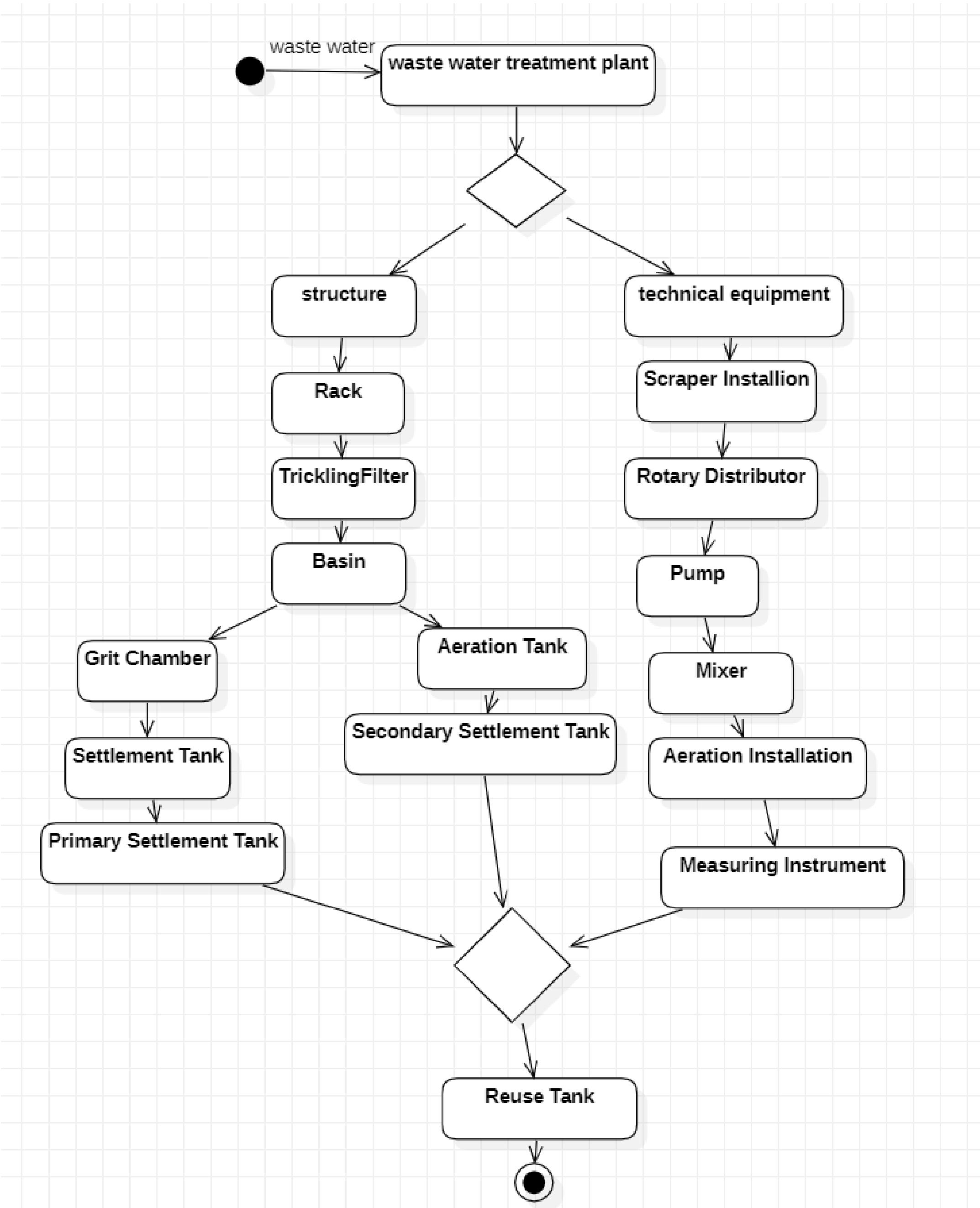
Class Diagram is a type of static structure diagram that describes the structure of a system by showing the system’s classes, their attributes, operations, and the relationships among objects. Here the system is the Waste water treatment plant.

## CODE:

```
#ifndef _WASTE WATER TREATMENT PLANT_H
#define _WASTE WATER TREATMENT PLANT_H

class Waste Water treatment plant {
};

#endif //_WASTE WATER TREATMENT PLANT_H


#ifndef _TRICKLING FILTER_H
#define _TRICKLING FILTER_H

#include "structure.h"


class Trickling Filter: public structure {
};

#endif //_TRICKLING FILTER_H

#ifndef _TECHNICAL EQUIPMENT_H
#define _TECHNICAL EQUIPMENT_H

class Technical equipment {
public:
   void Scraper Installation;
   void Rotary Distributor;
   void Pump;
   void Mixer;
   void Aeration Installation;
   void Measuring Instrument;
};

#endif //_TECHNICAL EQUIPMENT_H

#ifndef _STRUCTURE_H
#define _STRUCTURE_H

class structure {
};

#endif //_STRUCTURE_H

#ifndef _RACK_H
```

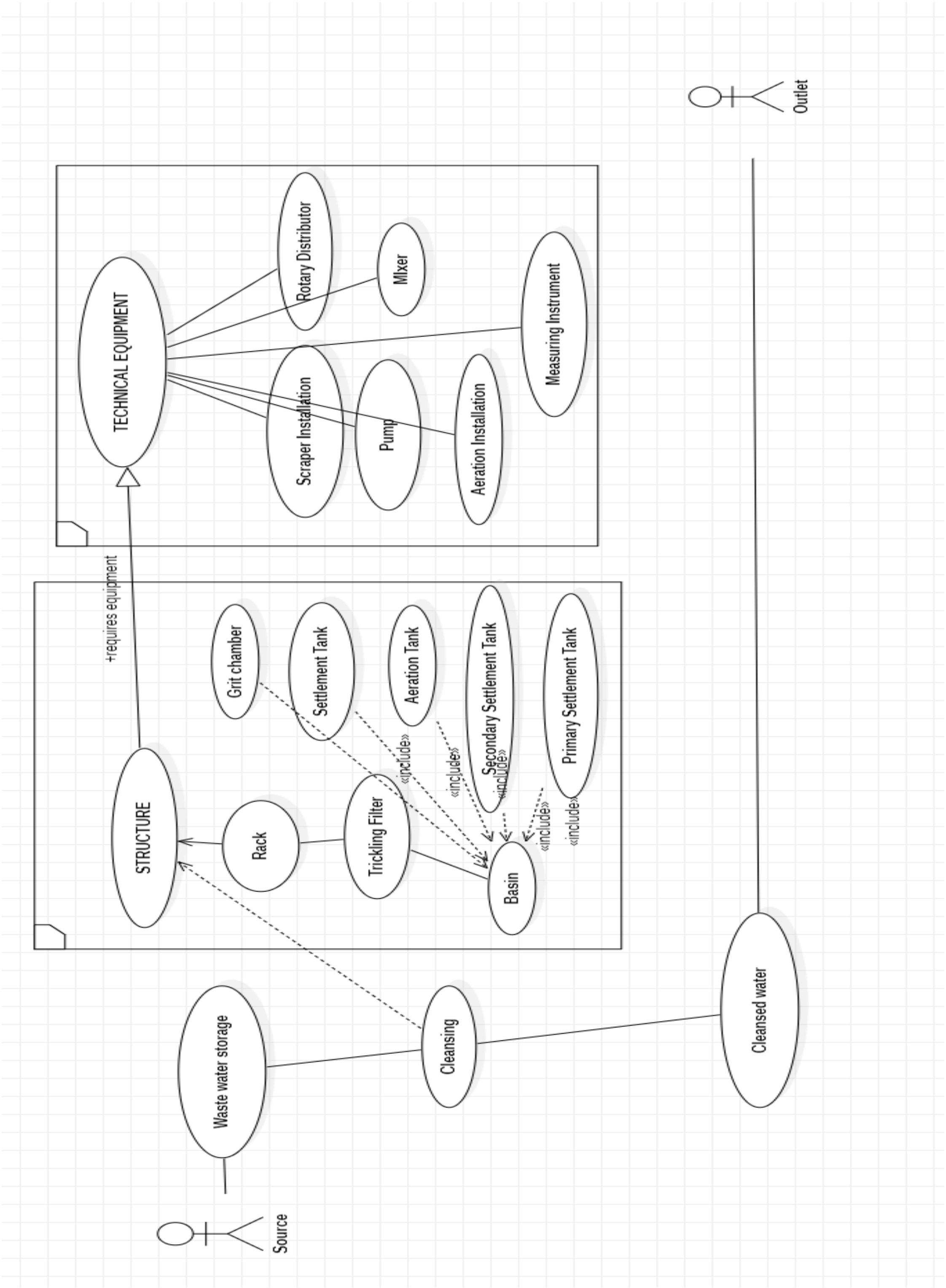
```
#define _RACK_H

#include "structure.h"


class Rack: public structure {
};

#endif //_RACK_H

#ifndef _BASIN_H
#define _BASIN_H

#include "structure.h"


class Basin: public structure {
public:
    void Grit Chamber;
    void Aeration Tank;
    void Primary Settlement Tank;
    void Secondary Settlement Tank;
    void Settlement Tank;
};

#endif //_BASIN_H
```

# ACTIVITY DIAGRAM



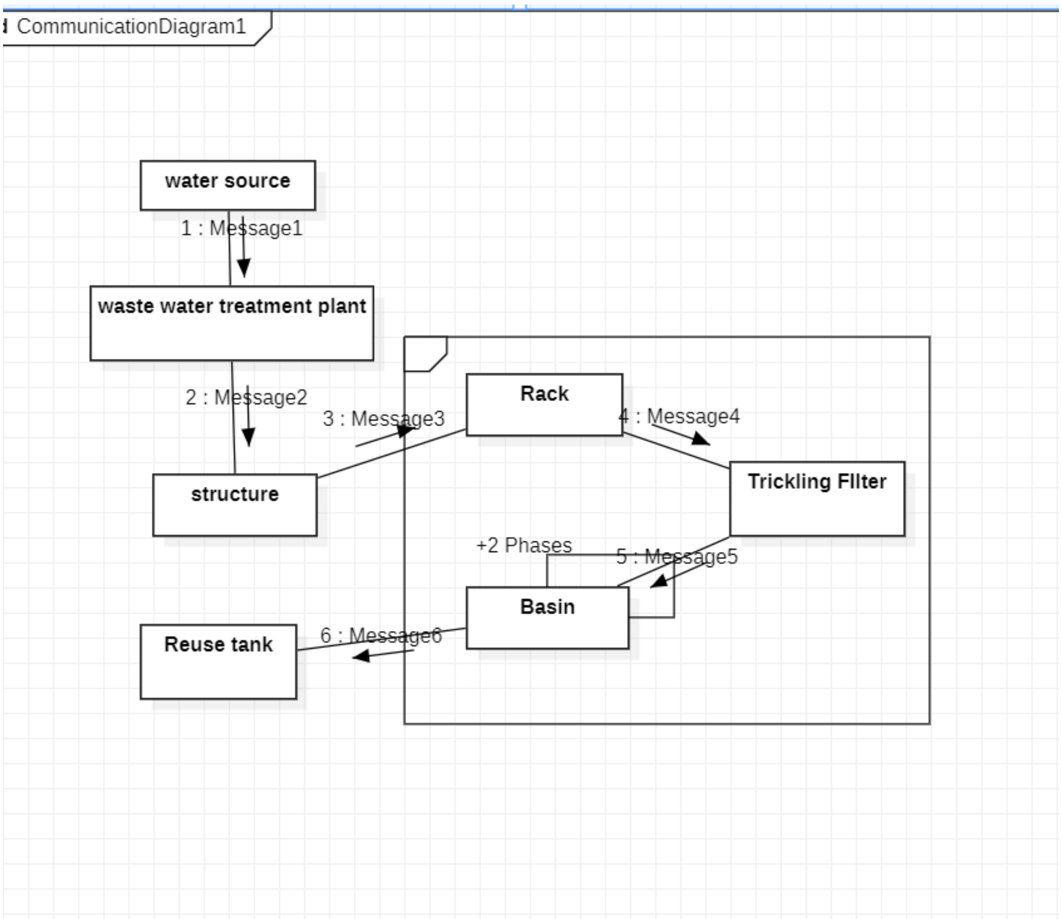

Activity diagrams describe the activities of a class. They are like state transition diagrams and use similar conventions, but activity diagrams describe the behavior/states of a class in response to internal processing rather than external events.

# USE CASE DIAGRAM



The objective of a UML use case diagram is to show the interactions of numerous items called actors with the use case and to capture fundamental functionalities of the Waste water treatment plant.

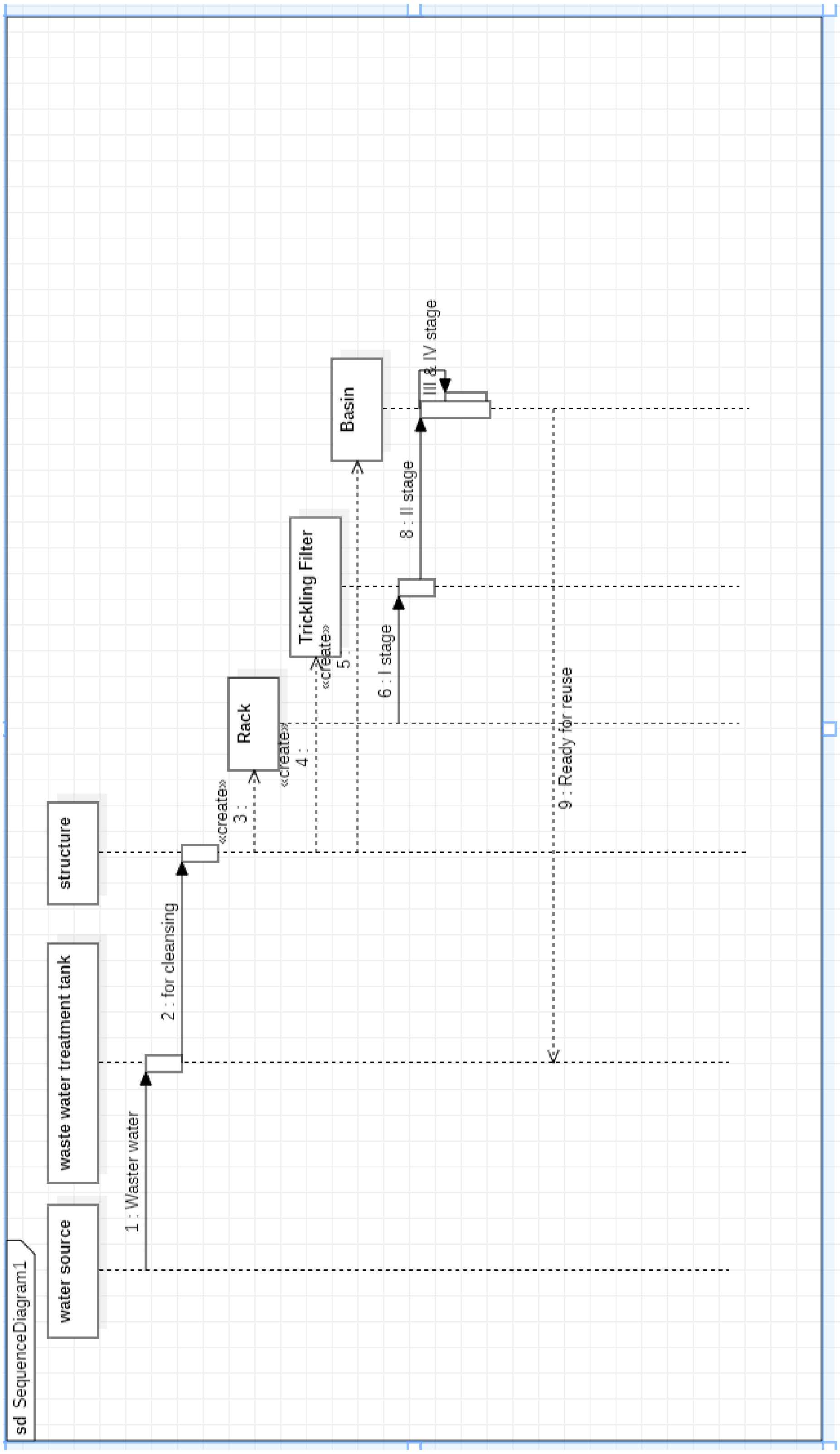
# COLLABORATION DIAGRAM / COMMUNICATION DIAGRAM:




A communication diagram is an extension of object diagram that shows the objects along with

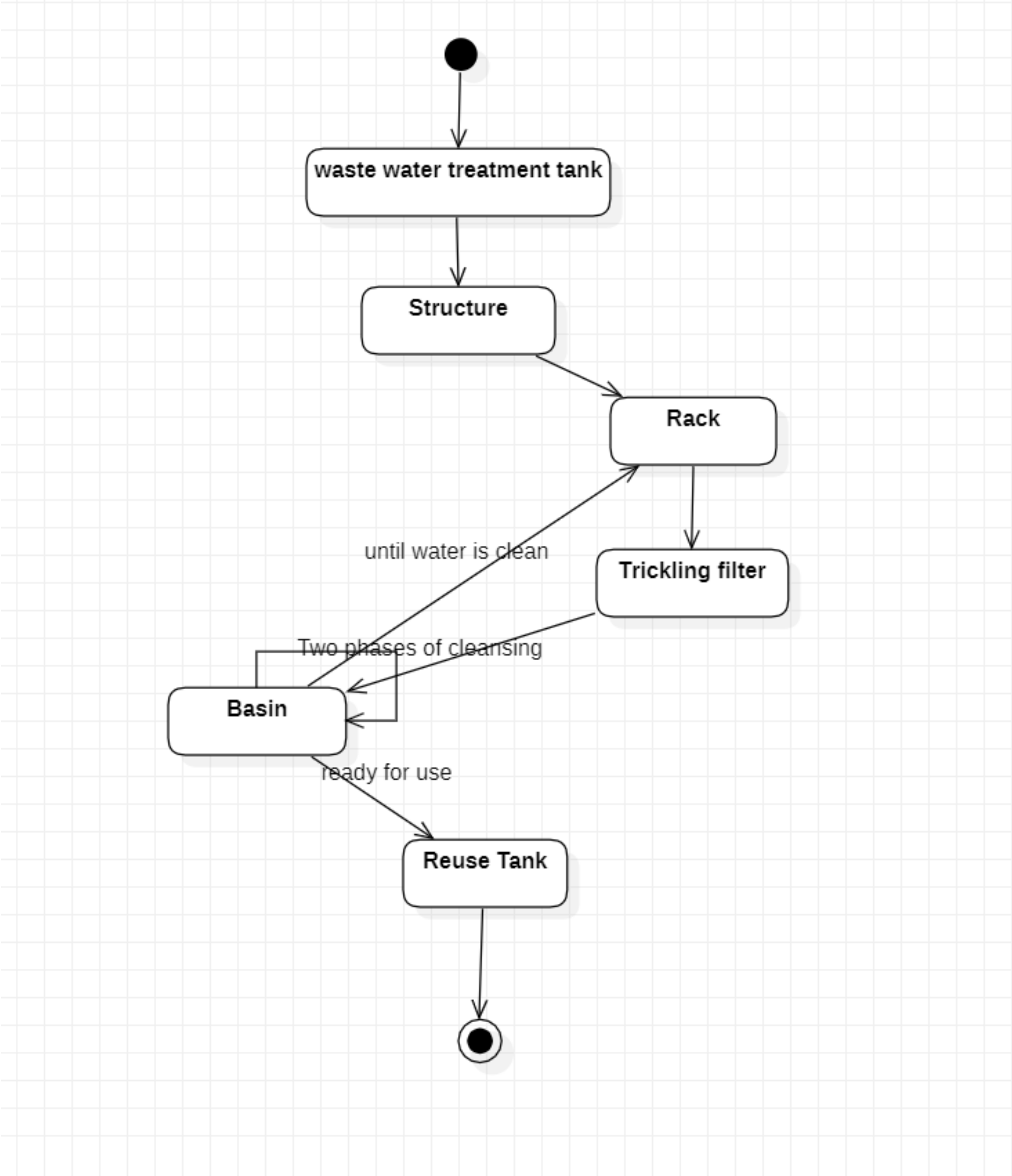
the messages that travel from one to another. In addition to the associations among objects, communication diagram shows the messages the objects send each other.

# SEQUENCE DIAGRAM:



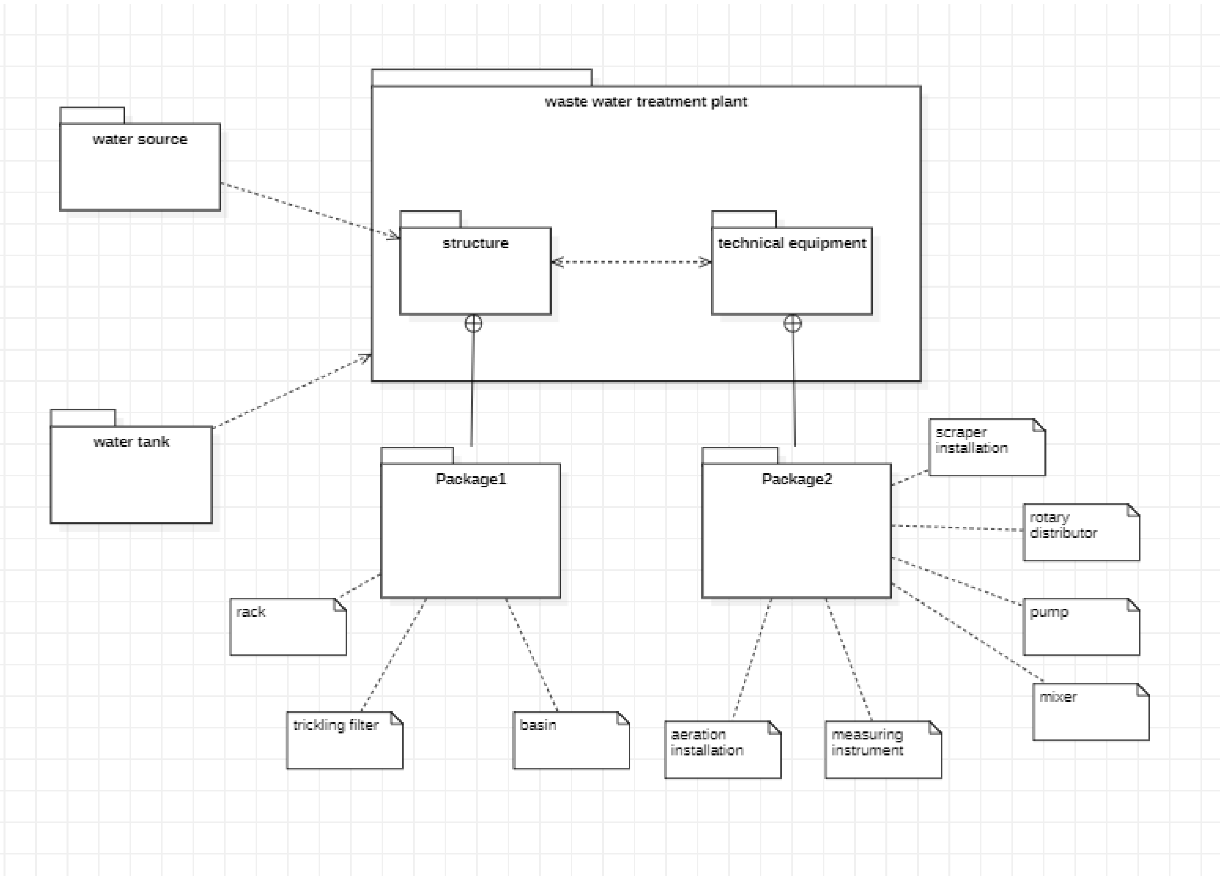
Sequence diagram s object interactions arranged in time sequence. It depicts the objects involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of Online Ticket Booking System.

# STATE DIAGRAM:



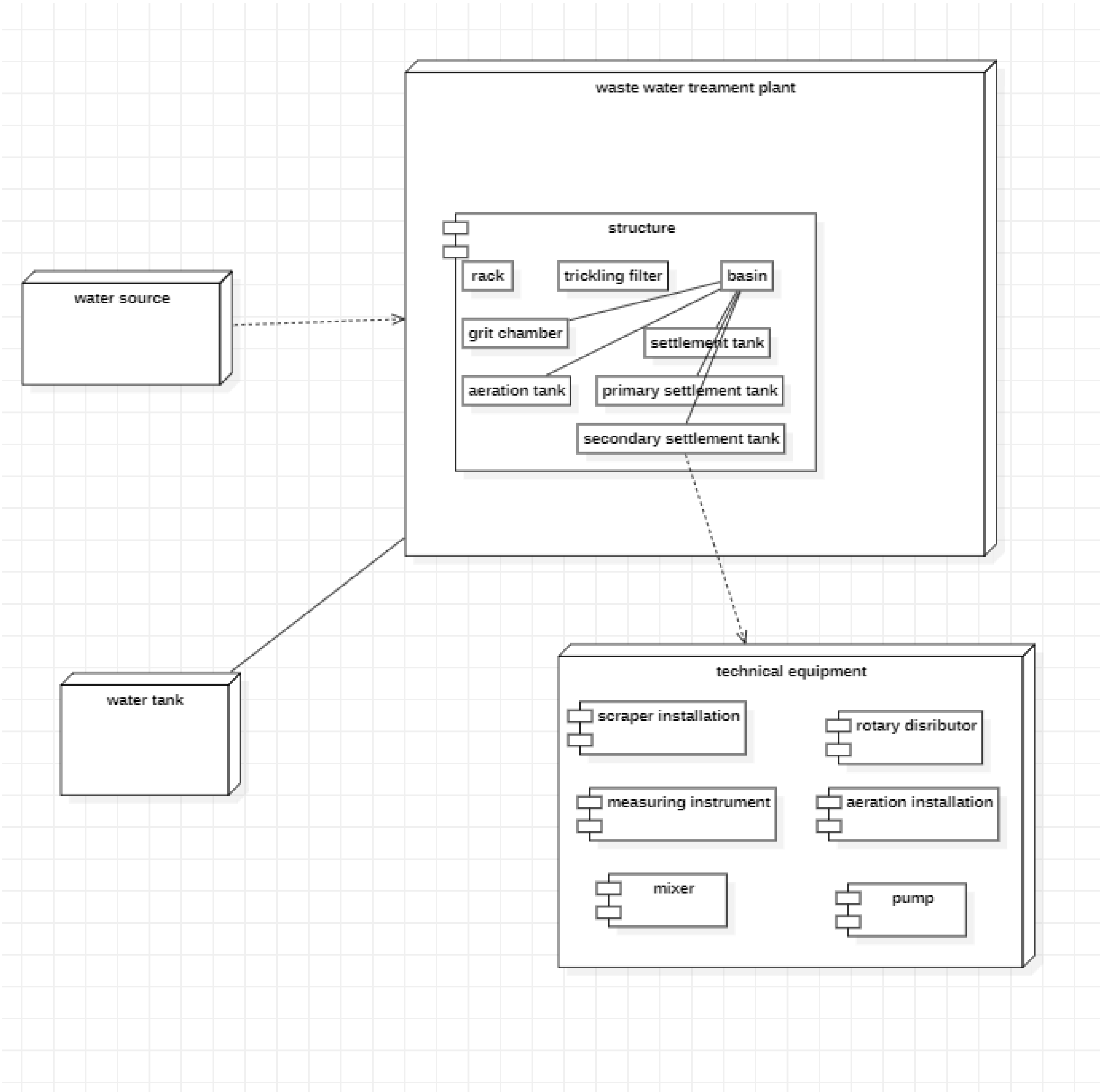

State transition diagrams provide a way to model the various states in which an object can exist. While the class diagram shows a static picture of the classes and their relationships, state transition diagrams model the dynamic behavior of a system in response to external events (stimuli).

# PACKAGE DIAGRAM:



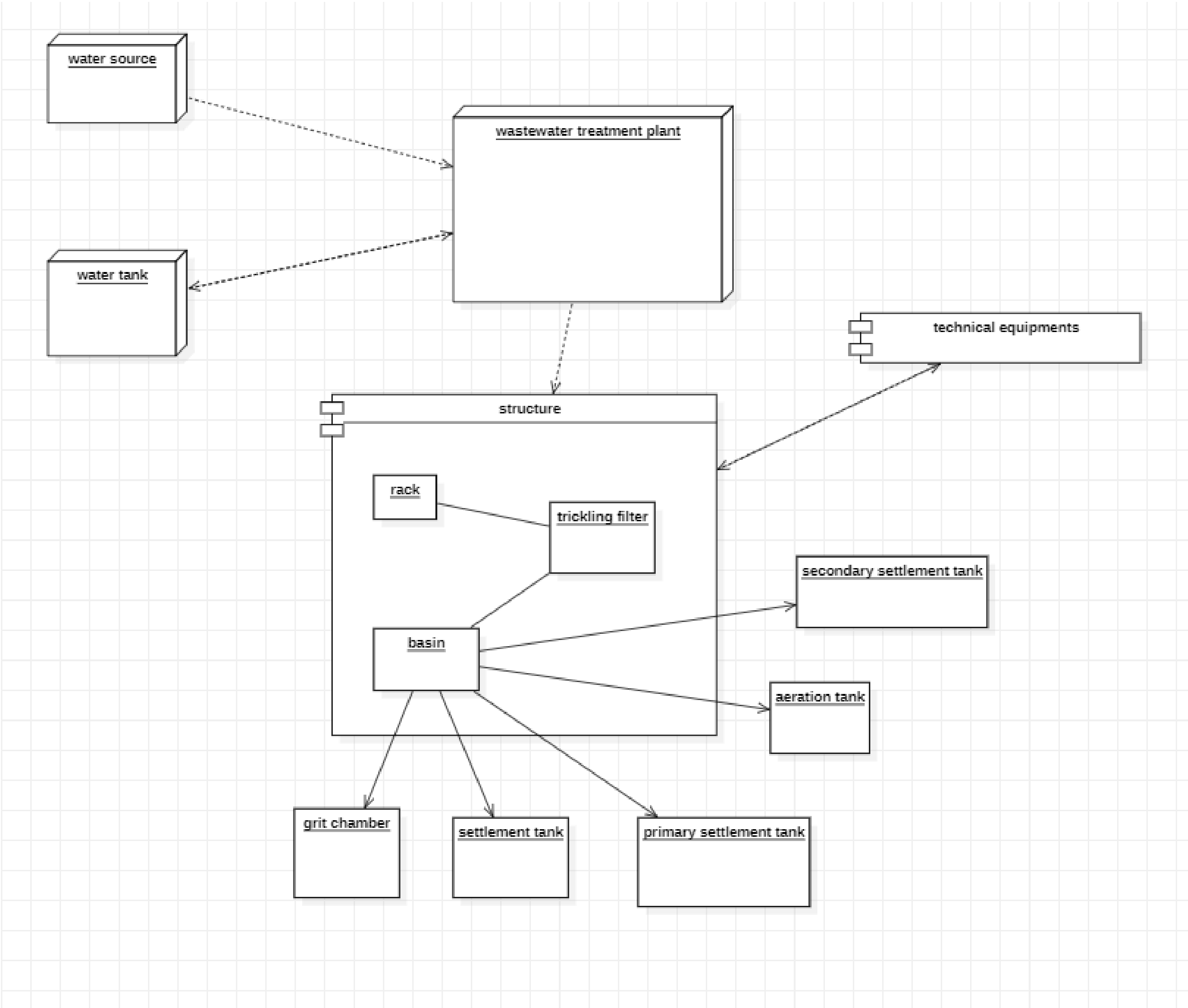

Package diagrams are structural diagrams used to show the organization and arrangement of various model elements in the form of packages. A package is a grouping of related UML elements, such as diagrams, documents, classes, or even other packages.

# DEPLOYMENT DIAGRAM:




A deployment diagram in the Unified Modeling Language serves to model the physical deployment of artifacts on deployment targets. Deployment diagrams show the allocation of Artifacts to Nodes according to the Deployments defined between them. Deployment of an artifact to a node is indicated by placing the artifact inside the node.

# COMPONENT DIAGRAM:




A component diagram in the Unified Modeling Language depicts how components are

wired together to form larger components and or software systems. Components

diagrams can be used to illustrate the structure of arbitrarily complex systems.

# CONCLUSION

The Waste Water treatment plant is a system which helps in the cleansing of polluted water. This project gives the insight on how the waste water treatment plant system works and explains it varies functions and specialties, different methods of cleansing for different types of waste water. Waste Water treatment plants help in the reuse of water over a large scale, this project further explains the systematic working of water treatment plant thereby making it trouble-free for people to understand. It even avoids the contamination of rivers and seas. It aims to eliminate the dangers to the aquatic life cause of the tainted water.