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# Kondapur(V), Ghatkesar(M), Medchal(Dist)

# Subject Name: INDUSTRIAL WASTE WATER TREATMENT

**Prepared by (Faculty (s) Name):S.SANDEEPKUMAR**

**Year and Sem, Department:IV / II**

**Unit-I: (**INTRODUCTION**)**

**1.Inorganic salts**: Inorganic salts, which are present in most industrial wastes as well as in nature itself, cause water to be "hard" and make a stream undesirable for industrial, municipal and agricultural usage. Salt laden waters deposit scale on municipal water- distribution pipelines, increasing resistance to flow and lowering the overall capacity of the lines. Another disadvantage is that, under proper environmental conditions, inorganic salts especially nitrogen and phosphorous induce the growth of microscopic plant life (algae) in surface waters

**2.Acids and /or Alkalis**: Acids and Alkalis discharged by chemical and other industrial plants make a stream undesirable not only recreational uses such as swimming and boating, but also for propagation of fish and other aquatic life. High concentrations of sulfuric acid, sufficient to lower the pH below 7.0 when free chlorine is present, have been reported to cause eye irritation to swimmers. A low ph may cause corrosion in air conditioning equipment and a ph greater than enhances laundering

**3.Organic matter**: Organic Matter exhausts the oxygen resources of rivers and creates unpleasant tastes, odours and general septic conditions. It is generally conceded that the critical range for fish survival is 3to 4 mg/l of D.O certain organic chemicals such as phenols, affect the taste of domestic water supplies.

**4.Suspended solids**: Suspended solids settle to the bottom or wash up on the banks and decompose, cause sing odours and depleting oxygen in the river water. Fish often die because of a sudden lowering of the oxygen content of a stream. Visible sludge creates unsightly conditions and destroys the use of a river for recreational purposes. These solids also increase the turbidity of the watercourse.

**5.Floating Solids and liquids**: These includes oils, greases, and other materials which float on the surface, they not only make the river unsightly but also obstruct passage of light through the water, retarding the growth of vital plant food.

Some specific objections to oil in streams are that it

* + 1. Interferes with natural reaeration
		2. is toxic to certain species of fish and aquatic life
		3. Causes trouble in conventional water treatment processes by imparting tastes and odours to water and coating sand filters with a tenacious film.

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**5.Heated Water**: An increase in water temperature, brought about by discharging wastes such as condenser waters in to streams, has various adverse effects. Streams waters which vary in temperature from one hour to the next are difficult to process efficiently in Municipal and industrial water treatment plants, and heated stream water are of decreased value for industrial cooling, indeed are industry may so increase the temperature of a stream that a neighboring industry downstream cannot use the water since there may be less D.O in warm water than in cold, aquatic life suffers and less D.O is available for natural biological degradation of any organic pollution discharged into these warm surface waters. Also bacterial action increases in higher temperatures, resulting in accelerated repletion of the streams oxygen resources.

**6.Colour** : Colour is contributed by textile and paper mills, tanneries, slaughterhouses and other industries, is an indicator of pollution. Colour interferes with the transmission of sunlight into the stream and therefore lessens photosynthetic action. Furthermore, municipal and industrial water plants have great difficulty, and scant success in removing colour from raw water.

**7.Toxic chemicals**: Both inorganic and organic chemicals, even in extremely low concentrations, may be poisonous to fresh water fish and other smaller aquatic microorganisms. Many of these compounds are not removed by municipal treatment plants and have a cumulative effect on biological systems.

**8.Microorganisms** : A few industries, such as tanneries and slaughterhouses, sometimes discharge wastes containing bacteria. These bacteria are of two significant types:

1. bacteria which assist in the degradation of the organic matter as the waste moves down stream. This process may aid in "seeding" a stream and in accelerating the occurrence of oxygen sag in water.
2. bacteria which are pathogenic, not only to other bacteria but also to humans.

**9.Radio Active Materials**: Cumulative damaging effects on living cells.Foam Producing Matter: Foam producing matter such as is discharged by textile mills, paper and pulp mills and chemical plants, gives an undesirable appearance to the receiving streams. It is an indicator of contamination and is often more objectionable in a stream than lack of oxygen.

**10.Effects On Sewage Treatment Plants**:

The Pollution Characteristics of Wastes having readily definable effects on Sewers and Treatment Plants can be Classified as follows:

**11.Bio Chemical Oxygen Demand**: It is usually exerted by Dissolved and Colloidal Organic Matter and imposes a load on the Biological units of the Treatment Plant. Oxygen must be provided so that Bacteria

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can grow and oxidise the organic matter. An Added B.O.D load, caused by an increase in Organic Waste, requires more Bacterial Activity, more oxygen, and greater Biological Unit capacity for its Treatment, which (makes) increases the capital cost and operating cost.

**12.Suspended Solids**: Suspended Solids are found in considerable quantity in many Industrial Wastes, such as Paper& Pulp Effluents. Solids removed by settling and separated from the flowing Sewage are called Sludge, which may then undergo an Anaerobic Decomposition known as Digestion and pumped to drying beds or vacuum filters for extraction of additional water. Suspended Solids in Industrial Waste may settle more rapidly or slowly than Sewage Suspende Matter. If Industrial Solids settle faster than those of Municipal Sewage, Sludge should be removed at shorter intervals to prevent excessive build up: a Slow Settling one will require a longer detention period and larger basins and increases the likelihood of sludge Decomposition with accompanying nuisances, during Sewage-Flow Periods.

Any Increased demands on the System usually require larger Sludge handling devices and may ultimately necessitates an increase in the Plants capacity, with resulting Higher Capital and Operating Expenses.

13.**Floating and Coloured Materials**: Floating Materials and Coloured Matter such as Oil, Grease and Dyes From Textile-Finishing Mills, are disagreeable and visible nuisances. A Modern Treatment Plant will remove normal Grease loads in Primary Settling Tanks, but abnormally high loads of predominantly emulsified Greases from Laundries, Slaughterhouses etc Passing through the Primary Units into the Biological Units will clog Flow Distributing Devices and Air Nozzles.

Volume: A Sewage Plant can handle any Volume of Flow if its units are sufficiently large. The Hydraulic Capacity of all Units must be analysed, Sewer Lines must be examined for Carrying Capacity, and all other Treatment Units are to be Designed for excessive loading

14.**Harmful Constituents**:Toxic Metals, Acids, or Alkalis, Pieces of Fat, Flammable Substances, Detergents and Phenols etc. cause nuisance in Treatment Pla

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**Short Questions**

1. Define Industrial wastewater
2. Define wastewater treatment
3. Write a short note on effluent and Influent of a Industry
4. What are different sources of pollution?
5. Write the physical properties of Industrial Waste Water.
6. Write the Chemical properties of Industrial Waste Water
7. Write the Organic properties of Industrial Waste Water
8. Write the Biological properties of Industrial Waste Water.
9. Write a short note on Domestic waste water
10. Write a short note on Industrial waste water

**LONG Questions**

1. Explain in detail about the different sources of Industrial waste waters
2. Discuss in detail about the Physical properties of Industrial wastewater
3. Discuss in detail about the Chemical properties of Industrial wastewater
4. Discuss in detail about the Organic properties of Industrial wastewater
5. Discuss in detail about the Biological properties of Industrial wastewater
6. Explain the difference between Industrial and Municipal wastewaters
7. Explain in detail the effects of Industrial effluents on sewers.
8. Explain in detail the effects of Industrial effluents on Natural water bodies.
9. Give the detailed information with respect to Waste water sources and its characteristics.
10. Give the detailed information with respect to manufacturing process
11. Describe the following characteristics of waste water in detail of the following 1. pH, 2. Solids, 3. BOD, 4. COD, 5. Heavy Metals
12. State the various types of benefits of water pollution control by doing treatment of industrial waste.
13. State the importance of Industrial waste treatment.
14. What are the factors affecting self purification of polluted streams? Give suggestions to control?
15. Explain briefly the methods of removal of suspended solids from industrial waste water

Multiple Choice Questions **/ Choose the Best: (Minimum 10 to 15 with Answers)**

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| 1.  | The minimum recommended diameter of sewers, is |
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|  |  |
| --- | --- |
| **A.** | 5 cm |
| **B.** | 10 cm |
| **C.** | 15 cm |
| **D.** | 20 cm. |

**Answer:** Option **C** |

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| 2.  | Aerobic bacterias |
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| **A.** | flourish in the presence of free oxygen |
| **B.** | consume organic matter as their food |
| **C.** | oxidise organic matter in sewage |
| **D.** | All the above. |

**Answer:** Option **D** |
| 3.  | The rate of accumulation of sludge in septic tanks is recommended as |
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|  |  |
| --- | --- |
| **A.** | 30 litres/person/year |
| **B.** | 25 litres/person/year |
| **C.** | 30 litres/person/month |
| **D.** | 25 litres/person/month. |

**Answer:** Option **A**

|  |  |
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| 4.  | If 2% solution of a sewage sample is incubated for 5 days at 20°C and depletion of oxygen was found to be 5 ppm, B.O.D. of the sewage is |
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| **A.** | 200 ppm |
| **B.** | 225 ppm |
| **C.** | 250 ppm |
| **D.** | None of these. |

**Answer:** Option **C** |
| 5.  | If *D* is the diameter of upper circular portion, the overall depth of a standard egg shaped section, is |
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| **A.** | *D* |
| **B.** | 1.25 *D* |
| **C.** | 1.5 *D* |
| **D.** | 1.75 *D* |
| **E.** | 2 *D*. |

**Answer:** Option **C** |
| 6.  | If the diameter of sewer is 225 mm, the gradient required for generating self cleansing velocity, is |
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|  |  |
| --- | --- |
| **A.** | 1 in 60 |
| **B.** | 1 in 100 |
| **C.** | 1 in 120 |
| **D.** | none of these. |

**Answer:** Option **C** |
| 7.  | Pick up the correct statement from the following : |
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|  |  |
| --- | --- |
| **A.** | pH value indicates acidity and alkalinity of sewage |
| **B.** | In acidic sewage, the pH value is less than 7 |
| **C.** | In alkaline sewage, the pH value is more than 7 |
| **D.** | Fresh sewage is generally alkaline |
| **E.** | All the above. |

**Answer:** Option **E****:** |

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| 8.  | The non-clog pump which permits solid matter to pass out with the liquid sewage, is |
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| --- | --- |
| **A.** | centrifugal pump |
| **B.** | reciprocating pump |
| **C.** | pneumatic ejector |
| **D.** | none of these. |

**Answer:** Option **A** |
| 9.  | Assertion (A) : Discharging the effluents from the oxidation ponds just up stream of lakes or reservoirs is undesirable.Reason (R) : The discharged algae get settled in the reservoirs and cause anaerobic decomposition and other water qualities. |
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| **A.** | Both A and R are true and R is the correct explanation of A |
| **B.** | Both A and R are true but R is not a correct explanation of A |
| **C.** | A is true but R is false |
| **D.** | A is false but R is true. |

**Answer:** Option **A** |
| 10.  | The width of a rectangular sewer is twice its depth while discharging 1.5 m/sec. The width of the sewer is |
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|  |  |
| --- | --- |
| **A.** | 0.68 m |
| **B.** | 0.88 m |
| **C.** | 1.36 m |
| **D.** | 1.76 m. |

**Answer:** Option **C** |

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**Unit-II: (DESIGN OF PRELIMINARY AND PRIMARY TREATMENT OPERATIONS)**

1. Screening:

It is a process through which large materials like wooden pieces, metal pieces, paper, rags, pebbles, fibres etc. are removed. The rotary and circulation filters are used now a days in modern industries to remove large materials.

These both methods are effective and help in reducing suspended solids and BOD of the industrial effluent. The micro strainer is also used to remove five suspended particles in some treatment processes. To remove, colloidal matter, ultra filters are also used although they are costly.

1. Neutralization:

When pH of the industrial waste is too high or too low then it should be neutralized by acid or alkali and only neutral effluent should be discharged into the nullah or public sewer.

1. Lime stone treatment:

For acidic effluent, lime stone should be used as it will form calcium compounds [CaCl2, CaBr2, Ca(NO3) or CaSO4] depending upon the presence and amount of acid.

b) Caustic soda treatment:

Although it is costly method but it is also utilized for neutralizing the acid. Here caustic soda is added in the effluent to make the pH neutral. Only small amount of caustic soda is needed for this work.

For neutralization of alkaline effluent the following techniques are used.

1.Carbon dioxide treatment:

If factory is producing carbon dioxide then only this method should be utilized for neutralizing the pH otherwise it would be costlier affair. Here CO2 is passed in alkaline effluent to make its pH almost 7.

2.Sulphuric acid treatment:

This is a common method of neutralizing alkaline effluent. Here sulphuric acid is added in the effluent till pH becomes almost 7.

3.Utilizing waste boiler – Flue gas:

The stack gas which contains about 12% carbon dioxide is utilized to react alkaline effluent to make it neutral.

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4.Equalization:

When effluent is discharged from factory then its pH along with the quantity of suspended solids, dissolved solids etc. vary from the beginning to the last depending upon the dilution, velocity and the amount of reactants etc.

Hence as the character of the effluent do not remain the same throughout hence proper treatment is not possible. So equalization tank is necessary where effluent is keep for 10 hrs or more for the stabilization of pH and BOD. During equalization suspended solids settle down & new acid of alkaline treatment becomes economical.

5.Sedimentation:

This treatment is only employed for the settlement of suspended particles by gravity. This technique is only used in the beginning to settle down the solid particles in a high suspension effluent.

6. Coagulation:

Experimental results have shown that a slit particle of size 0.05 mm requires about 11 hours to settle down through a depth of 3 m and clay particles of size 0.002 mm require about 4 days‘ time to settle the same height of 3 m of at normal temperature of about 25°C. As we know that water contains colloidal impurities which are even finer than 0.0001 mm and which also carry electrical charge on them.

Due to electrical charges they remain in motion and never settle down. Therefore when water is turbid due to presence of such fine size and colloidal impurities, plain sedimentation is of no use. It is also not possible to provide detention periods of longer than 4 — 9 hours. The coagulation becomes necessary when the turbidity is more than 40 — 55 ppm.

For dealing waters with such impurities a chemical process was evolved. This process removes all these impurities within reasonable period of 3 — 4 hours. This chemical process is called coagulation and the chemical used in the process is called coagulant.

7.Principle of Coagulation:

The principle of coagulation can be explained from the following two aspects:

1.Floe formation, and

2.Electrical charges.

8.Floe formation:

When coagulant is added to the water and thoroughly mixed, it produces a thick insoluble gelatinous precipitate. This precipitate is called floe. The floe has the property of arresting the suspended impurities in water during its downward settlement towards the bottom of the tank.

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The gelatinous precipitate has therefore the property of removing fine and colloidal particles quickly. The coagulation process also removes colour and test in general.

9.Electrical charges:

The flock ions are electrically charged (positive) while all the colloidal particles have negative charge. Therefore floes attract the colloidal particles and cause their removal easily by settlement at bottom of the vessel in which it is used.

**Short Questions**

1. List the different stages of waste water treatment
2. Explain the different stages of wastewater treatment plant.
3. Write a short on Volume Reduction of Industrial waste water
4. Write a short note on Pre-treatment of waste water treatment
5. Write a short on Neutralization of Industrial waste water
6. Write a short on Equalization of Industrial waste water
7. Write a short on Proportioning of Industrial waste water
8. Give a short note on Oil Separation.
9. What are the different Chemical treatment methods of Industrial wastewater?
10. Give the different Methods for treating Organic matter

**LONG Questions**

1. Explain the necessity of equalization and proportioning for industrial waste water treatment..
2. Enumerate the basic theories of Industrial wastewater management and Explain the strength reduction
3. What is volume reduction? List and explain any four methods of the volume reduction in industrial wastewater?
4. What is the necessity of Neutralization in Industrial waste treatment? Explain the working of the same with suitable examples.
5. Explain the process of Oil Separation by floatation method.
6. Explain about the flow equalization process.? Explain the Neutralization process.
7. Discuss the phenomenon of discrete sitting of particles in Primary treatment process.
8. Explain the various methods of volume and strength reduction adopted for the industrial waste.
9. Brief the various aerobic and anaerobic treatment methods
10. Draw the sketches of following and explain the mechanism of the treatment.1) Stabilization ponds, 2) Oxidation ditch

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Multiple Choice Questions **/ Choose the Best: (Minimum 10 to 15 with Answers)**

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| 1.  | The most dangerous pollutant in vehicular emissions is |
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| **A.** | CO |
| **B.** | SO2 |
| **C.** | CO2 |
| **D.** | O3. |

**Answer:** Option **A** |
| 2.  | If the depletion of oxygen is found to be 2.5 mg/litre after incubating 2.5 ml of sewage diluted to 250 ml for 5 days at 20°C, B.O.D. of the sewage is |
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|  |  |
| --- | --- |
| **A.** | 50 mg/l |
| **B.** | 100 mg/l |
| **C.** | 150 mg/l |
| **D.** | 200 mg/l |
| **E.** | 250 mg/l. |

**Answer:** Option **E** |
| 3.  | The clarigesters are |
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| --- | --- |
| **A.** | circular septic tanks |
| **B.** | rectangular septic tanks |
| **C.** | circular Imhoff double tanks with bottom hoppers |
| **D.** | circular Imhoff double storey tanks without bottom hoppers. |

**Answer:** Option **D** |
| 4.  | Rate of flow of sewage is generally assumed |
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| --- | --- |
| **A.** | more than the rate of water supply |
| **B.** | equal to the rate of water supply |
| **C.** | less than the rate of water supply |
| **D.** | at 150 litres per capita. |

**Answer:** Option **C** |
| 5.  | Maximum permissible velocity 1.5 m/sec, is adopted in drains |
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|  |  |
| --- | --- |
| **A.** | with beds of rocks and gravels |
| **B.** | lined with stones |
| **C.** | both (a) and (b) |
| **D.** | neither (a) nor (b). |

**Answer:** Option **C** |

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| --- | --- |
| 6.  | The digested sludge from septic tanks, is removed after a maximum period of |
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| **A.** | 3 years |
| **B.** | 3.5 years |
| **C.** | 4 years |
| **D.** | 5 years. |

**Answer:** Option **A** |
| 7.  | For providing an Indian type W.C., the R.C.C. slabs in the toilet portion |
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| --- | --- |
| **A.** | should be sunk by 20 cm |
| **B.** | should be kept 20 cm above the adjacent portion |
| **C.** | should be sunk by 50 cm |
| **D.** | need not be sunk. |

**Answer:** Option **C** |
| 8.  | The gradient of sewers depends upon |
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|  |  |
| --- | --- |
| **A.** | velocity of flow |
| **B.** | diameter of the sewer |
| **C.** | discharge |
| **D.** | all the above. |

**Answer:** Option **D** |
| 9.  | The settling velocity of the particles larger than 0.06 mm in a settling tank of depth 2.4 is 0.33 m per sec. The detention period recommended for the tank, is |
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| --- | --- |
| **A.** | 30 minutes |
| **B.** | 1 hour |
| **C.** | 1 hour and 30 minutes |
| **D.** | 2 hours |
| **E.** | 3 hours. |

**Answer:** Option **D** |
| 10.  | The drop man holes are generally provided in sewers for |
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|  |  |
| --- | --- |
| **A.** | industrial areas |
| **B.** | large town ships |
| **C.** | hilly town ships |
| **D.** | cities in plains. |

**Answer:** Option **C** |

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**Unit-III: (Biological Treatment Processes**)

1. **Nitrification**

Nitrification is the biological process by which ammonia is first converted to nitrite and then to nitrate. Nitrification can be achieved in any aerobic-biological process at low organic loadings and where suitable environmental conditions are provided. Nitrifying bacteria are slower growing than the heterotrophic bacteria, which comprises the greater proportion of the biomass in both fixed film and suspended growth systems. The key requirement for nitrification to occur, therefore, is that the process should be so controlled that the net rate of accumulation of biomass, and hence, the net rate of withdrawal of biomass from the system, is less than the growth rate of the nitrifying bacteria (Barnes and Bliss, 1983). The processes currently used in the treatment of wastewater for nitrification are presented as follows.

**2.Trickling filters**

The extent of nitrification in trickling filters depended on a variety of factors; including temperature, dissolved oxygen, pH, presence of inhibitors, filter depth and media type, loading rate, and wastewater BOD (Parker and Richards, 1986). Low-rate trickling filters allowed the development of a high-nitrifying population.

3. **Rotating biological contractor**

RBC biofilm has an initial adsorption of microorganisms to the disk surface to form 1-4 mm thick biofilm that is responsible for BOD removal in rotating biological contractors. The rotating disks provided a large surface area for the attached biomass.

4. **Fixed bed reactor**

conducted a pilot scale research by using a fixed bed reactor for nitrification of the effluent from an extended aeration sewage treatment plant. The non-settled sewage influent of COD of 373 mg/L, NH4-N of 45 mg/L, SS of 297 mg/L and pH 8.1 were used in this study. With an HRT of 4 to 6 hours and recycle ratio of 3.5, removal efficiencies of 70% of COD, 67% of SS and 95% of NH4-N were obtained.

5. **Conventional activated sludge processes at low loadings**

Weismann (1994) studied the nitrification in a conventional activated sludge system and found that it was relatively low for carbon removal and nitrification of sewage because carbon removal and nitrification occurred in the same reactor with an activated sludge system. This resulted in a population mixture of mainly heterotrophs and few autotrophs.

6. **Two-stage activated sludge systems with separate carbonaceous oxidation and nitrification system**

The nitrification process requires a slow-growing nitrifying bacteria with sludge that has been aged for a long time and high dissolved oxygen concentration. In addition, they were susceptible to inhibition by a wide range of compounds at concentrations so low as not to affect the heterotrophic bacteria

7. **Denitrification**

Denitrification is the biological process by which nitrate is converted to nitrogen and other gaseous end products. The requirements for the denitrification process are: a) nitrogen present in the form of nitrates;

b) an organic carbon source, and c) an anaerobic environment

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**8.Continuous flow stirred reactor (CFSR)** nitrate feed rate and cell residence time on complete mixed continuous-flow stirred-reactor (CFSR) operated at the steady state. They concluded that denitrification processes could be operated at near maximum unit removal rates and still obtained acceptable nitrogen conversion (less than 2 mg of NO3-N/L in the denitrified effluent) also indicated that cell retention time in the reactor would depend on the organic carbon requirement and nitrate removal efficiency. An SRT of at least 4 days was recommended for design at 20 C and 30 C. An SRT of at least 8 days was recommended for design at 10 C.

9.**Activated sludge systems**

Lesouef, et al. (1992), demonstrated a test on a two zone in activated sludge systems and showed to be capable of removing 75% of the total N from about 30 mg TN/L in the feed to

< 10 mg TN/L in the effluent. The multiple anoxic zones with a step feed process had recently been modeled and appeared to be the most cost effective denitrification option because it made the fullest use of the carbon that was present in the feed as the carbon source for step feed denitrification.

10.**Fixed film reactor**

studied denitrification results from a fixed-film anoxic sand reactor used for the treatment of drinking water. The anoxic reactor was operated downflow at 20 m3/h with a nitrate loading of 0.4-1.5 kg NO3- N/m3/d. They found that nitrate removal rates using sugar or glucose syrup as organic carbon sources were usually greater than 95%.

**11.Carbon and Nitrogen Removal Process**

Currently, the processes used for carbon and nitrogen removal can be divided into two major groups: separated stage and single stage processes. For multiple stages of carbon and nitrogen removal, there is a disadvantage for denitrification which occurs either in the addition of external carbon or the recycle part of the effluent of nitrifying bacteria. Carbon and nitrogen removal occurring in a single unit is a possibility to overcome these disadvantages

12. **Phosphorous in wastewater**

Municipal wastewaters may contain from 5 to 20 mg/l of total phosphorous, of which 1-5 mg/l is organic and the rest in inorganic.

13. **Orthophosphates**: available for biological metabolism without further breakdown

**14.Polyphosphates**: molecules with 2 or more phosphorous atoms, oxygen and in some cases hydrogen atoms combine in a complex molecule.

15. **Enhanced biological phosphorus removal (EBPR)**

The greatest interest and most recent progress has been made in EBPR, which has the potential to remove P down to very low levels at relatively lower costs.

16. **Precipitation**

Chemical precipitation has long been used for P removal. The chemicals most often employed are compounds of calcium, aluminum, and iron .

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**Short Questions**

1.List the different treatment methods of Wastewater.

2.Write a short on Nitrification of Industrial waste water

1. Write a short on De-nitrification of Industrial waste water.
2. Write the flow sheet of Separate Nitrification System
3. Write a short note Biological De-nitrification.
4. Write the flow sheet of Separate De-nitrification System.
5. Give the importance of Phosphorous removal from industrial effluent.
6. List the different processes involved in removal of Phosphorous removal from industrial effluent..
7. Write a short on Membrane separation technologies in Phosphorous removal.
8. What is the process involved in chemical treatment in Phosphorous removal?

**LONG Questions**

**1.** Write an essay on heavy metal poisoning and their prevention with a

suitable example.

2. Explain Membrane separation technologies in Phosphorous removal and

write different types of Membrane filtration?

 3.Writea short notes on disposal of industrial wastewater after the treatment.

 4. What do you understand by equalization, neutralization and

proportioning? Give examples from industry?

 5. Why are solvents, grease, cyanide, phenol and sulphates considered undesirable for discharge into public sewers? Explain?

 6. Enlist & Explain the Factors Affecting Adsorption

1. Discuss any two special treatment methods for treating industrial waste water.
2. Elaborate any two disposal methods of treated industrial waste water.
3. Nothing is a waste – discuss the statement with respect to industrial

waste disposal.

10. List various effects of discharging raw industrial waste to the streams.

Briefly explain any four.

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Multiple Choice Questions **/ Choose the Best: (Minimum 10 to 15 with Answers)**

|  |  |
| --- | --- |
| 1.  | The pH value of fresh sewage is usually |
|

|  |  |
| --- | --- |
| **A.** | equal to 7 |
| **B.** | more than 7 |
| **C.** | less than 7 |
| **D.** | equal to zero. |

**Answer:** Option **B** |
| 2.  | The moisture content of a sludge is reduced from 90% to 80% in a sludge digestion tank. The percentage decrease in the volume of sludge, is |
|

|  |  |
| --- | --- |
| **A.** | 25% |
| **B.** | 50% |
| **C.** | 10% |
| **D.** | 5%. |

**Answer:** Option **B** |
| 3.  | Inter-distance between ventilation columns in a sewer line is kept |
|

|  |  |
| --- | --- |
| **A.** | 25 to 50 m |
| **B.** | 50 m to 100 m |
| **C.** | 100 m to 150 m |
| **D.** | 150 m to 300 m. |

**Answer:** Option **D** |
| 4.  | If *q* is the average sewage flow from a city of population *P*, the maximum sewage flow |
|

|  |  |
| --- | --- |
| **A.** | https://www.indiabix.com/_files/images/civil-engineering/waste-water-engineering/180-9.16-1.png |
| **B.** | https://www.indiabix.com/_files/images/civil-engineering/waste-water-engineering/180-9.16-2.png |
| **C.** | https://www.indiabix.com/_files/images/civil-engineering/waste-water-engineering/180-9.16-3.png |
| **D.** | https://www.indiabix.com/_files/images/civil-engineering/waste-water-engineering/180-9.16-4.png |

**Answer:** Option **C** |
| 5.  | The factor responsible for purification of sewage in river is |
|

|  |  |
| --- | --- |
| **A.** | Hydrology |
| **B.** | Dissolved oxygen in water |
| **C.** | Temperature |
| **D.** | Turbulence |
| **E.** | All the above. |

**Answer:** Option **E** |

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|  |  |
| --- | --- |
| 6.  | If the peak discharge of a storm water drain (S.W. Drain) is e.xpected to exceed 150 cumecs, the free board to be provided, is |
|

|  |  |
| --- | --- |
| **A.** | 100 cm |
| **B.** | 90 cm |
| **C.** | 80 cm |
| **D.** | 50 cm. |

**Answer:** Option **A** |
| 7.  | *PH* value of sludge during alkaline regression stage, is |
|

|  |  |
| --- | --- |
| **A.** | more than 7 |
| **B.** | less than 7 |
| **C.** | less than 6 |
| **D.** | more than 6. |

**Answer:** Option **A** |
| 8.  | Depletion of ozone layer in the outer atmosphere may cause |
|

|  |  |
| --- | --- |
| **A.** | lung cancer |
| **B.** | skin cancer |
| **C.** | bronchitis |
| **D.** | heart disorder. |

**Answer:** Option **B** |
| 9.  | The spacing of bars of perforations of fine screens used for the treatment of sewage, is |
|

|  |  |
| --- | --- |
| **A.** | 2 to 3 mm |
| **B.** | 3 to 5 mm |
| **C.** | 5 to 8 mm |
| **D.** | 8 to 10 mm. |

**Answer:** Option **A** |
| 10.  | The self-cleansing velocity of water flowing through pipe lines, is |
|

|  |  |
| --- | --- |
| **A.** | 2 metres/sec |
| **B.** | 1 metre/sec |
| **C.** | 0.5 metre/sec |
| **D.** | 0.25 metre/sec. |

**Answer:** Option **A** |

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**Unit-IV: (Activated Sludge Process)**

**1.Effects of the waste on receiving streams :**

The fresh effluent from the sugar mill decomposes rapidly after few hours of stagnation. It has been found to cause considerable difficulties when their effluent gets an access to the watercourse. The rapid depletion of oxygen due to biological oxidation followed by anaerobic stabilization of the waste causes a secondary pollution of offensive odour and black colour.

2. **Treatment :**

Disposal of the effluent on land as irrigation water is practical in many sugar mills, but it is associated with odour problem. The reasonable C.O.D/B.O.D ratio of the mill effluents indicate that the waste is amenable to biological treatment

3. **Bottling**

Raw milk received is weighed and classified (generally based on the fat content), it is preheated, pasteurized, cooled and then filled into bottles, polythene bags, cardboard packets etc.

4.**Product Making**

Dry milk, milk powder, cheese, butter and other products as ice cream, condensed milk are prepared out of milk.

**5.Sources of wastes:**

Waste producing operations are washing of bottles, cases, cans, tanks, cooling equipment, Processing equipment and floors.

6. **Characteristics of wastes:**

They are wholly organic with high oxygen demand (Milk is a balanced food for bacteria, therefore it is consumed at a faster rate depleting the oxygen)

1kg of whole milk produces about 10kg of BOD

BOD= 300 to 3000mg/l and BOD/COD very high (0.68) indicating degradability of the waste

7. **Treatment of Waste:**

As evident from the high BOD/COD ratio, the dairy wastes can be treated efficiently by biological processes.

Reduction of volume and strength of the wastes by:

1. Prevention of spills, leakages and dropping of milk from cans.
2. By reducing the amount of water for washes
3. By segregating the uncontaminated cooling water and recycling the same.

8. **Meat Processing**

Meat is the dressed flesh derived from cattle, buffalow, sheep, goat, pigs and poultry

**9.Pulp and Paper Mill Waste**

The paper mills use the 'pulp' as the raw material , which is again produced utilizing different cellulosic materials like wood , bamboo,jute, straw mainly of rice and wheat, waste paper, bagasse etc in the pulp mills.

#### 10. Lagooning: In small mills , where the black liquor is not treated separately for the chemical recovery, the strong black liquor must be segregated from the other wastes and stored in a lagoon.

11. **Treatment of Coal Washery Waste**

The major pollutant of the coal washery is the suspended solids. AS such this waste is usually treated in a Clarifier with or without coagulation. However the addition of Coagulant reduces both the detention time and surface area of the tank.

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**12.What is Metal Platting** :

Plating is the application of a plate, or coat, of metal to a surface for decoration, reflection of light, protection against corrosion, or increased wearing quality. Electroplating is the most common method because it permits the control of the thickness of the plating. We offer: Gold, Nickel, Copper, and Chrome plating

13. **What is Electroplating :**

Electroplating is the deposition of a metallic coating onto an object by putting a negative charge onto the object and immersing it into a solution which contains a salt of the metal to be deposited. The metallic ions of the salt carry a positive charge and are attracted to the part. When they reach it, the negatively charged part provides the electrons to reduce the positively charged ions to metallic form.

**14.Cleaning** :

The materials to be plated when received in plating shop usually contain oils or greases on its surface given as a protection coating. They are removed by warm alkali. This process is also called as alkaline degreasing. The spent alkaline liquor have high pH , suspended solids and contains soaps, grease and oil. After degreasing the materials are given washing in stationary baths or in running water which are discharged continuously. The rinse and washing effluents are usually alkaline.

**15.Stripping (Acid Pickling) :**

It is a process usually carried on iron materials by which the rust and scales adhering to the metallic surface are removed by treatment with sulphuric or hydrochloric acid. The spent liquors are not discharged continuously. Though the volume of these spent liquors is much less, they are strong wastes, and causes serious effects.

16. **Plating** :

The pickled materials are placed as Cathode in suitable electrolytic cells. The plating baths are usually acidic in nature and contain sulfuric, hydrochloric or nitric acids. Alkaline baths containing carbonate, hydroxide and cyanide are also used. Cyanides are used in plating baths as they are good oxide solvents and they yield a brighter and less porous plates.

17. **Effects on sewers :**

Plating is the application of a plate, or coat, of metal to a surface for decoration, reflection of light, protection against corrosion, or increased wearing quality. Electroplating is the most common method because it permits the control of the thickness of the plating. We offer: Gold, Nickel, Copper, and Chrome plating

18. **Effects on streams :**

Very small concentrations of cyanide , chromic acid and chromates, heavy metal compounds of cadmium , copper , lead , nickel and zinc are toxic to aquatic life . In high concentrations they are toxic to humans also. As they are toxic to microbiological and biological organisms self purification is inhibited. Further, iron and tin impart colour to the receiving stream. The colloidal and other suspended impurities render a bad appearance to the stream.

19. **Treatment of Fertilizer Waste Water :**

Major pollutants in the fertilizers waste water for which the treatment is necessary include oil, arsenic, ammonia, urea, phosphate and fluoride.

The effluent streams can be characterized as either a phosphoric effluent or an ammonia effluent. The phosphoric acid effluent is high in fluoride concentration, low in pH, High in phosphate and high in suspended solids.

20. **Effects of Wastes on receiving streams:**

All the components of the waste from the fertilizer plants induced adverse effects in the stream. Acids and Alkalis can destroy the normal aquatic life in the stream. Arsenic, Fluorides and Ammonium salts are found to be toxic to the fishes.

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**Short Questions**

1. Give a brief note on sources of wastewater from sugar industry
2. What are the different characteristics of sugar industry effluent?
3. Draw a neat sketch of the process of Sugar Industry
4. Give the values of different characteristics of sugar mill waste.
5. What is the effect of waste from sugar mill on receiving streams?
6. What are the different characteristics of Food Processing Industries effluent?
7. Draw a neat sketch of the process of Food Processing Industries.
8. What is the effect of waste from Food Processing Industries on receiving streams?
9. Give a brief note on sources of wastewater from Steel industry.
10. Draw a neat sketch of the process of Steel Industry.

**LONG Questions**

1. Characterize the various treatment processes for food and beverage

industry waste water. What are the prospects of waste utilization from food industry?

2. Describe the impacts of petroleum exploration and its production on the

environment.

3. Describe in detail some methods for controlling the pollution from food

and beverage Industries.

4. a) Between BOD and COD, which one usually assumes higher value for

a food plant? Justify your answer

5. Discuss the characteristics of petrochemical Industrial wastewater

6. Discuss the characteristics of Sugar mill waste water.

7. What are the various polluting effluents generated by integrated steel

plants?

8. Give the characteristics and treatment of the wastes from sugar industry?

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Multiple Choice Questions **/ Choose the Best: (Minimum 10 to 15 with Answers)**

|  |  |
| --- | --- |
| 1.  | A nuisance is experienced in diluting water if dilution factor is less than |
|

|  |  |
| --- | --- |
| **A.** | 100 |
| **B.** | 60 |
| **C.** | 40 |
| **D.** | 20 |
| **E.** | 10 |

**Answer:** Option **D** |
| 2.  | Traps |
|

|  |  |
| --- | --- |
| **A.** | are water seals which prevent the entry of foul gases |
| **B.** | are used to trap the rats entering sewers |
| **C.** | dissolve the foul gases |
| **D.** | create syphonic action to increase the quick disposal of sewerage. |

**Answer:** Option **A** |
| 3.  | For estimating the peak run off the rational formula *Q* = 0.0278 KpA was evolved by |
|

|  |  |
| --- | --- |
| **A.** | Kinchling |
| **B.** | Lloyd Davis |
| **C.** | Frubling |
| **D.** | all the above. |

**Answer:** Option **D** |
| 4.  | Pick up the correct statement from the following : |
|

|  |  |
| --- | --- |
| **A.** | Inlets are provided on the road surface at the lowest point for draining rain water |
| **B.** | Inlets are generally provided at an interval of 30 m to 60 m along straight roads |
| **C.** | Inlets having vertical openings, are called curb inlets |
| **D.** | Inlets having horizontal openings, are called horizontal inlets |
| **E.** | All the above. |

**Answer:** Option **E** |
| 5.  | Pick up the correct statement from the following : |
|

|  |  |
| --- | --- |
| **A.** | The boning rod is used for checking the levels of the sewer inverts |
| **B.** | Manhole covers are made circular for the convenience of the cleaning staff |
| **C.** | A manhole is classified as deep manhole if its depth is more than 1.5 m |
| **D.** | A manhole is classified as shallow manhole if its depth is. less than 0.9 m |
| **E.** | All the above. |

**Answer:** Option **E** |

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|  |  |
| --- | --- |
| 6.  | 3.0 ml of raw sewage is diluted to 300 ml. The D.O. concentration of the diluted sample at the beginning of the test was 8 mg/l. After 5 day-incubation at 20°C, the DO. concentration was 5 mg/l. The BOD of raw sewerage is |
|

|  |  |
| --- | --- |
| **A.** | 100 mg/l |
| **B.** | 200 mg/l |
| **C.** | 300 mg/l |
| **D.** | 400 mg/l. |

**Answer:** Option **C** |
| 7.  | The arrangement made for passing the sewer line below an obstruction below the hydraulic gradient lines called |
|

|  |  |
| --- | --- |
| **A.** | inverted syphon |
| **B.** | depressed sewer |
| **C.** | sag pipe |
| **D.** | all of these. |

**Answer:** Option **D** |
| 8.  | The angle subtended by the surface of sewer water with partial flow, at sewer centre is 120°, the depth of sewerage is |
|

|  |  |
| --- | --- |
| **A.** | 20 cm |
| **B.** | 25 cm |
| **C.** | 40 cm |
| **D.** | 50 cm |
| **E.** | 60 cm. |

**Answer:** Option **D** |
| 9.  | Imhoff cone is used to determine |
|

|  |  |
| --- | --- |
| **A.** | settlable solids |
| **B.** | suspended solids |
| **C.** | dissolved solids |
| **D.** | none of these. |

**Answer:** Option **A** |
| 10.  | The sewage discharge in a detritus tank of a treatment plant is 576 litres/sec with flow velocity of 0.2 m/sec. If the ratio of width to depth is 2, the depth is |
|

|  |  |
| --- | --- |
| **A.** | 100 cm |
| **B.** | 110 cm |
| **C.** | 120 cm |
| **D.** | 150 cm. |

**Answer:** Option **C** |

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**Unit-V: (Sludge Treatment and Disposal)**

**1.Tanning Process :**

The tanning process consists of three basic stages

* 1. Preparation of the hides for tanning.
	2. Tanning proper.
	3. Finishing.

**2.Sources of waste water and their characteristics :**

# The waste may be classified as continuous flow waste and intermittent flow waste. Continuous flow waste consists of wash wastes after various processes and comprise of a large portion of the total waste, and are relatively less polluted than the other one

**3. Effects of waste on receiving water and sewers:**

# Tannery wastes are characterized by high BOD, high-suspended solids and strong color. These wastes when discharge as such deplete the dissolved oxygen of the stream very rapidly, due to both chemical and biological oxidation of sulfur and organic compounds

**4. Textiles Mills Waste**

The Fibres used in the Textile Industry may be broadly classified into four groups : cotton, wool, regenerated and synthetics.

**5. Synthetic Textile Mill Waste:**

The most prominant man made synthetic fibers are Rayon, nylon and polyster. These fabrics require no processing for the removal of natural impurities as they are man made.

Manufacture of synthetic fabrics involve two steps:

1.manufacture of the synthetic fibre and

2.preparation of the cloth.

### 6.Treatment of Cotton and Woolen Textile Mill Waste :

# The pollution load of the waste is dealt with in the operations like segregation, equalization, neutralization, chemical precipitation, chemical oxidation and biological oxidation. Several chemicals are used to reduce the BOD by chemical coagulation.

7. **Effects of the cotton textile and woolen textile mill wastes on receiving streams / sewers :**

# The crude waste, if discharged into the streams, causes rapid depletion of the dissolved oxygen of the streams. The condition aggravates due to the settlement of the suspended substances and subsequent decomposition of the deposited sludges in anaerobic condition.

**8. Woolen Textile Mills waste :**

Wool wastes originate from scouring , carbonizing , bleaching , dyeing , oiling , fulling and finishing operations.

# Impurities of raw wool, consisting mainly of wool grease and other foreign matter are removed by scouring the wool in hot detergent alkali solution. Some wool are scoured by organic solvents

**9.Cotton textile mill waste:**

An integrated cotton textile mill produces its own yarn from the raw cotton. Production of yarn from raw cotton includes steps like opening and cleaning, picking, carding, drawing, spinning, winding and warping. All these sequences are dry operations and as such do not contribute to the liquid waste of the mill.

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10.Carding :It is a process in the manufacture of spun yarns whereby the staple is opened, cleaned, aligned and formed into a continuous untwisted strand called sliver.

11.Drawing :It is the process of increasing the length per unit weight of sliver.

12.Combing :A method to remove short fibers, foreign matter from cotton stock by pressing it through a series of needles or combs.

13.Spinning :It is a process by which a long strand of fibres is drawn out to a short strand and converted into a yarn. After drawing out, it is subjected to twisting and the resulting yarn is wound into a bobbin.

14.Winding :It is the process of transfer of a yarn or threadfrom one type of package to another.

15.Weaving :It is the process of interlocking two yarns of similar materials so that they cross each other at right angles to produce a woven fabric.The entire liquid waste from the textile mills comes from the following operation of slashing (or sizing), scouring and desizing, bleaching, mercerizing, dyeing and finishing.

**Short Questions**

1.Give a brief note on sources of wastewater from Textiles Industry?

 2.What are the different characteristics of Textiles Industry effluent?

 3.Draw a neat sketch of the process of Textiles Industry?

 4.Give the values of different characteristics of Textiles Industry waste.

 5. What is the effect of waste from Textiles Industry on receiving streams?

 6. Write a brief note on sources of wastewater from Tanneries Industry.

7. What are the different characteristics of Tanneries Industry effluent?

8. Draw a neat sketch of the process of wastewater generated in Tanneries

Industry?

 9. Give the values of different characteristics of Tanneries Industry waste?

10. Give a brief note on sources of wastewater from Atomic Energy Plants?

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**LONG Questions**

1.With the neat process flow sheet, highlight the origin and characterization of wastewater generated in typical tannery industry?

2. Sketch the neat process flow sheet, highlight the origin and characterization of wastewater generated in textile industry?

3. Discuss the characteristics of tannery waste.

4. Explain the advantaged and limitations of combined treatment of industrial waste and municipal waste water.

5. What are the sources of various pollution in an integrated cotton Textile mill? Give a plan for the control of this pollution.

6. What are the advantages of combined treatment of industrial waste water with domestic waste water?

7. Explain the Neat flow diagram a working of a CEPT. What are the situations in which it is used?

8. Describe the characteristics of Atomic Energy plants effluents.

9. Describe the characteristics of Mineral processing Industrial effluents

10. Explain the design procedure of Common Effluent Treatment Plants(CEPT).

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Multiple Choice Questions **/ Choose the Best: (Minimum 10 to 15 with Answers)**

|  |  |
| --- | --- |
| 1.  | Sewer pipes need be checked for |
|

|  |  |
| --- | --- |
| **A.** | minimum flow |
| **B.** | maximum flow |
| **C.** | both (a) and (b) |
| **D.** | none of these. |

**Answer:** Option **C** |
| 2.  | If D.O. concentration falls down to zero in any natural drainage, it indicates the zone of |
|

|  |  |
| --- | --- |
| **A.** | degradation |
| **B.** | active decomposition |
| **C.** | recovery |
| **D.** | cleaner water |
| **E.** | none of these. |

**Answer:** Option **B** |
| 3.  | The ratio of design discharge to the surface area of a sedimentation tank is called |
|

|  |  |
| --- | --- |
| **A.** | surface loading |
| **B.** | overflow rate |
| **C.** | overflow velocity |
| **D.** | all of these. |

**Answer:** Option **D** |
| 4.  | The value of Chezy's constanthttps://www.indiabix.com/_files/images/civil-engineering/waste-water-engineering/181-9.31-1.pngis used in |
|

|  |  |
| --- | --- |
| **A.** | Chezy's formula |
| **B.** | Bazin's formula |
| **C.** | Kutter's |
| **D.** | Manning's formula. |

**Answer:** Option **C** |
| 5.  | In the activated sludge process |
|

|  |  |
| --- | --- |
| **A.** | aeration is continued till stability |
| **B.** | aeration is done with an admixture of previously aerated sludge |
| **C.** | sludge is activated by constant stirring |
| **D.** | water is removed by centrifugal action. |

**Answer:** Option **B** |


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|  |  |
| --- | --- |
| 6.  | The minimum diameter of a sewer is kept |
|

|  |  |
| --- | --- |
| **A.** | 10 cm |
| **B.** | 15 cm |
| **C.** | 20 cm |
| **D.** | 25 cm |
| **E.** | 30 cm. |

**Answer:** Option **B** |
| 7.  | The minimum diameter of sewer to be adopted is |
|

|  |  |
| --- | --- |
| **A.** | 10 cm |
| **B.** | 12.5 cm |
| **C.** | 15 cm |
| **D.** | 25 cm. |

**Answer:** Option **C** |
| 8.  | To test chemical oxygen demand (C.O.D.) of sewage, organic matter is oxidised by pottassium dichromate in the presence of |
|

|  |  |
| --- | --- |
| **A.** | Hydrochloric acid |
| **B.** | Sulphuric acid |
| **C.** | Nitric acid |
| **D.** | Citric acid. |

**Answer:** Option **B** |
| 9.  | The discharge per unit plan area of a sedimentation tank, is generally called |
|

|  |  |
| --- | --- |
| **A.** | over flow rate |
| **B.** | surface loading |
| **C.** | over flow velocity |
| **D.** | all the above. |

**Answer:** Option **D** |
| 10.  | In a sedimentation tank (length *L*, width *B*, depth *D*) the settling velocity of a particle for a discharge *Q*, is |
|

|  |  |
| --- | --- |
| **A.** | https://www.indiabix.com/_files/images/civil-engineering/waste-water-engineering/190-9.166-1.png |
| **B.** | https://www.indiabix.com/_files/images/civil-engineering/waste-water-engineering/190-9.166-2.png |
| **C.** | https://www.indiabix.com/_files/images/civil-engineering/waste-water-engineering/190-9.166-3.png |
| **D.** | https://www.indiabix.com/_files/images/civil-engineering/waste-water-engineering/190-9.166-4.png |

**Answer:** Option **D** |