

GUJARAT TECHNOLOGICAL UNIVERSITY

4th Semester Civil Engineering – PDDC

Subject Code & Name: X40601 - Environmental Engineering

Sr. No.	Course content
1.	Water Demands: Various types of water demands, the per capita demand, factors affecting per capita demand, waste and losses, variations in demand, design periods, population forecasting methods.
2.	Collection and Conveyance of Water: Intakes, types of intakes, design of intakes, conveyance of water, design of pump and rising mains.
3.	Water Treatment Processes: Water supply scheme, plain sedimentation, types of sedimentation, sedimentation tank & its design, sedimentation with coagulation, types of coagulants, optimum dose of coagulants, mixing devices, design of flocculator. Theory of filtration, types of filters and their comparison, design of rapid sand filter, washing of filter, troubles in filter. Methods of disinfection, action of chlorine, types of chlorination. Methods of removing temporary and permanent hardness.
4.	Distribution System: Layout of distribution networks, methods of water distribution, storage capacities of elevated service reservoirs, and underground service reservoir.
5.	Collection and Estimation of Sewage: Different types of sewers, design period, variations in sewage flow, estimation of waste water discharge.
6.	Hydraulic Design of Sewer: Hydraulic formulae, maximum and minimum velocities in sewer, hydraulic characteristics of circular sewer in running full and partial full conditions, laying and testing of sewer, sewer appurtenances and network.
7.	Unit Operations for Waste Water Treatment: Physical unit operation-Screening, flow equalization, mixing, flocculation, sedimentation. Chemical unit processes-Chemical precipitation. Biological unit processes: Aerobic attached growth and aerobic suspended growth treatment processes, anaerobic suspended growth treatment process.
8.	Design of Facilities for Physical, Chemical & Biological Treatment of Waste Water: Design of racks, screens, grit chamber, aeration units, sedimentation tanks, activated sludge and trickling filter processes, rotating biological contactors, sludge digesters and drying beds,
9.	Low Cost Sanitation System: Septic tanks, soak pit, stabilization ponds, packaged treatment plant.
10.	Introduction to tertiary waste water treatment
Term Work : Term work shall be based on the above mentioned course content.	
Field Visit: Field visits based on course content are suggested.	
References Books: <ol style="list-style-type: none">1. Environmental Engg. Vol. 1 & 2 by B.C. Punmia2. Environmental Engg. Vol. 1 & 2 by S.K. Garg3. Environmental Engg. by Peavy, Rowe, Tchobanoglous	

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER-IV • EXAMINATION – SUMMER • 2014

Subject Code: X40601**Date: 17-06-2014****Subject Name: Environmental Engineering****Time: 10:30 am - 01:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain factors affecting rate of demand. **07**
 (b) Explain variation in rate of demand. **07**

- Q.2** (a) Explain factors affecting the location of intake. **07**
 (b) The following data have been noted from the census department. **07**

Year	1981	1991	2001	2011
Population	15000	23500	34000	50000

Calculate the probable population for the year 2031 and 2041 by arithmetic increase method and geometric increase method.

OR

- (b) Design procedure for intakes. **07**
- Q.3** (a) What is the importance of water supply scheme? Explain with neat sketch components of water supply scheme. **07**
 (b) Explain in detail tree system of water distribution network. **07**

OR

- Q.3** (a) How optimum dosage of coagulant can be determined? Explain in detail. **07**
 (b) Explain gravity system method for water distribution. **07**

- Q.4** (a) What are the types of aerators? Explain with neat sketch cascade and inclined apron aerators. **07**
 (b) Describe concept of flocculation with neat sketch. **07**

OR

- Q.4** (a) Give comparison between slow sand filters and rapid sand filters. **07**
 (b) Explain in brief about disinfection with requirement of disinfectants. **07**

- Q.5** (a) Design a suitable grit chamber to cater a town of 2.2 lakh population with 155 lpcd sewage contribution. Assume peak factor=1.5. **07**
 (b) Differentiate between trickling filter and activated sludge plant on any seven points. **07**

OR

- Q.5** (a) What is self cleansing velocity of waste water flow in the sewers? What is dry weather flow? **07**
 (b) Calculate the diameter and discharge of a circular sewer laid at a slope of 1 in 550 when it is running half full, and with a velocity of 1.1 m/s. Use Manning's equation. Take $n=0.012$. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER-IV • EXAMINATION – WINTER 2013

Subject Code: X40601**Date: 03-12-2013****Subject Name: Environmental Engineering****Time: 02.30 pm - 05.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Describe various factors affecting per capita demand of water. **07**
 (b) Why coagulants are added to raw water ? state the reasons for using alum salt as coagulant. **07**

- Q.2** (a) The following is the population data of a city available from past census records. Determine the population of the city in 2031 by (1) arithmetic increase method (2) geometrical increase method. **07**

Year	1951	1961	1971	1981	1991	2001	2011
Population	117000	173000	28500	417000	571000	679500	743000

- (b) Explain non-silting, non-scouring velocity with reference to design of sewers. **07**

OR

- (b) Write Short note on "Rapid Sand Filter". **07**

- Q.3** (a) Explain different factors affecting the site selection for an intake structure **07**
 (b) How storm water discharge and domestic waste discharge are estimated for design of sewers? **07**

OR

- Q.3** (a) What are the objectives of water treatment? **07**
 (b) Give the classification of different types of pumps used in water supply. **07**

- Q.4** (a) Find the settling velocity of spherical silica particle of sp.Gr. 2.65 in water of 25°C if the diameter of particle is 0.03mm. take kinematic viscosity of water at 25°C = 0.009 sqcm / sec. **07**
 (b) Explain with neat sketch working and cleaning of rapid sand filter. **07**

OR

- Q.4** (a) What is grit chamber? Why it is necessary to provide this in the treatment of sewage? Discuss the design criteria of same. **07**
 (b) How will you select treatment scheme for a municipal wastewater treatment plant? Draw layout plan of a typical municipal wastewater treatment plant and explain in detail its units. **07**

- Q.5** (a) Design a circular sewer running half-full at a peak flow of 0.8m³/sec. Take Manning's constant N=0.012 and assume it to be constant with respect to depth of flow. The maximum permissible velocity at the time of peak flow is 0.8m/sec. **07**

- (b) A city with 2.5 lakh population is to be supplied water at 130 lpcd from a river 1.5 km away. The difference in water level of sum[and reservoir is 30m. If the demand has to be supplied in 8 hours, determine the size of the raw water main and B.H.P of the pumps to be installed. Assume maximum demand as 1.5 times the average demand. Take $f=0.0075$, velocity in the pipe as 2.0m/s and efficiency of pump as 80%. **07**

OR

- Q.5** (a) Write short note on” Septic tank” **07**
(b) Explain with neat sketch Reservoir Intake structure. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**PDDC - SEMESTER-IV • EXAMINATION – SUMMER 2013****Subject Code: X40601****Date: 04-06-2013****Subject Name: Environmental Engineering****Time: 10:30 am – 01:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain water demand for public uses and fire. **07**
(b) Explain various factors affecting rate of water demand. **07**

- Q.2** (a) What is intake? Explain design procedure for intakes. **07**
(b) Explain in detail plain sedimentation. **07**

OR

- (b) Explain with neat sketch about determination of optimum coagulant dose. **07**

- Q.3** (a) Explain tree and reticulation systems with advantages and disadvantages for layout of distribution network. **07**
(b) What is disinfection? Enumerate different methods of disinfection & explain chlorination in detail. **07**

OR

- Q.3** (a) Explain in brief different methods of removing temporary and permanent hardness from water. **07**
(b) Explain with neat sketch different methods of distribution of water. **07**

- Q.4** (a) What is grit chamber? Why it is necessary to provide this in the treatment of sewage? Discuss the design criteria of a grit chamber giving its neat sketch. **07**
(b) Determine the velocity of flow in case of circular cast iron sewer 1.6 m diameter laid on a slope of 1 in 500 when it is running full. **07**

OR

- Q.4** (a) Design a grit chamber having a rectangular cross-section for the following data: **07**
Maximum flow: 15 MLD
Diameter of the smallest grid particles to be removed = 0.2mm.
Average temperature = 21° C. Sp. Gravity of grid particles = 2.67.
(b) Classification of sewers according to the construction materials. **07**

- Q.5** (a) Write short note on activated sludge process. **07**
(b) Give the comparison between high rate and conventional trickling filters. **07**

OR

- Q.5** (a) Explain in detail about septic tank. **07**
(b) What is population forecast? Why it is required in the design of water treatment plant. State the different methods of forecasting future population and describe any one. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**PDDC - IVth Semester–Examination – May- 2012****Subject code: X40601****Subject Name: Environmental Engineering****Date: 08/05/2012****Time: 02:30 pm – 05:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain the theory of plain sedimentation for water treatment process and derive the equation for settling velocity for discrete particles when Reynold's No. is 1 to 1000 and particle size is varying from 0.1 to 1 mm diameter. **07**
- (b) Find the settling velocity of a spherical silica particle of Sp. Gr. = 2.67 in water at temperature of 28⁰ C if the diameter of particle is 0.015mm. Take the kinematic viscosity of water at 28⁰ C = $85 \times 10^{-2} \text{ cm}^2/\text{s}$. **07**

- Q.2** (a) Explain the terms: (i) Detention time, (ii) Overflow Rate and (iii) Hydraulic Loading. Also explain the variation in the demand of water. **07**
- (b) What is population forecast? Why it is needed for the design of either water or waste water treatment plant? State the different methods of forecasting the future population and explain any one in detail **07**

OR

- (b) Why coagulants are added to raw water? State the reasons for using alum salt as coagulant universally. **07**
- Q.3** (a) Explain: (i) Break down and (ii) Equalizing storages for determining the storage capacity of elevated service reservoirs. **07**
- (b) Explain the mass curve method to find the balancing storage of an elevated service reservoir. **07**

A town with a population of 50,000 has a continuous water supply. Average water supply is 180 lpcd, water is being supplied by direct pumping. The total supply of water during the day is distributed percentage wise as follows:

Time	%
5am to 11am	45
11am to 3pm	25
3pm to 9pm	15
9pm to 12midnight	10
12midnight to 5am	05

Water is supplied from the treatment plant at a uniform rate of 3.75million lit/hr for all 24 hours. Find out the capacity of the reservoir required for the distribution of water. Adopt analytical method to find the storage capacity. Assume no loss or draw from the trunk main.

OR

- Q.3** (a) State and explain the theory of filtration. State the cleaning process of Rapid Gravity Filters. **07**
- (b) Design the approximate dimensions of a set of rapid gravity filters for treating water required for a city having the population of 1, 00,000. The rate of supply being 160 lpcd. The rate of filtration of water is assumed as 5,000 lit/hr/sq.m. Assume other additional data if required. Take maximum demand = 2.5 times the **07**

average demand.

Q.4 (a) State the different factors affecting the selection of a pump. Where does sewage pumping differ from water pumping activity? **07**

(b) A town has a population of 80,000. The average water supply rate is 150lpcd. Assuming 80% of water reaches the sewage pumping station; determine the BHP of pumping unit if the sewage is to be pumped against a head of 6.0mt. The length of rising main is kept as 250 m with $f=0.02$. Assume (i) Maximum demand = 2.5 times the average demand (ii) Velocity in rising main = 1.0 m/s (iii) Minimum time of continuous pumping = 20 minutes. (iv) Loss of head in valves, bends etc = 0.5m. (v) Efficiency of pumps and motors = 75% and 85% respectively. Find the BHP for maximum demand of water only. **07**

OR

Q.4 (a) What is nitrification? Discuss the effects of pH, DO and temperature on it. **07**

(b) Discuss the different methods for disposal of septic tank effluent. **07**
Calculate the bottom area of trenches for septic tank when effluent maximum discharge is 1.0 lit/sec and standard percolation time of 36 minutes.

Q.5 (a) Explain the terms: (i) Dry weather flow and (ii) Wet weather flow. Draw a labeled diagram of drop manhole. **07**

(b) Calculate the velocity of flow and corresponding discharge in a sewer of a circular section having diameter = 1 m laid at a gradient of 1 in 450. The sewer runs at 0.7depth. Use Manning's formula. Take $N = 0.015$. **07**

OR

Q.5 (a) Explain why preliminary treatment is being given to the waste water? Write design criteria for horizontal flow grit chamber. **07**

(b) A grit chamber is to be designed with a proportionate flow weir at its outlet to handle a sewage flow for a city having population of 80,000 and per capita daily consumption of water is 140 liters. Assume maximum flow = 2.5 times the average flow. Take detention period of grit chamber = 1 minute, the depth of flow = 1.2 m and free board of 0.3 m. Assume other additional data if required. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**PDDC SEM-IV Examination-Nov-2011****Subject code: X40601****Date: 21/11/2011****Subject Name: Environmental Engineering****Time: 2.30 pm -5.00 pm****Total marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain the terms: (i) Detention time, (ii) Overflow rate and (iii) Hydraulic loading. **07**
- (b) Design a grit chamber having a rectangular cross-section for the following data: **07**
 Maximum Flow = 20 MLD
 Diameter of the smallest grit particles to be removed = 0.2mm.
 Average temperature = 20⁰ C. Sp. Gr. of grit particles = 2.67.
- Q.2** (a) State and explain various points for the location of waste water treatment plant. **07**
- (b) Explain the theory of sedimentation process and derive the equation for settling velocity for discrete particles when Reynolds' number is 1 to 1000 and particle size is varying from 0.1 to 1 mm diameter. **07**
- OR**
- (b) Find the settling velocity of a spherical silica particle of Sp. Gr. = 2.67 in water at 25⁰ C, if the diameter of particle is 0.02mm. Take dynamic viscosity of water at 25⁰ C = 0.9x10⁻² cm²/sec. **07**
- Q.3** (a) State the properties of common coagulants. **07**
- (b) Why coagulants are added to raw water? Explain the reason why Alum salt is used universally as coagulant. Also write the chemical reactions of Alum salt with water. **07**
- OR**
- Q.3** (a) What is population fore cast? State the different methods of it and explain any one in detail. **07**
- (b) The following is the population record of a city available from past census records. Determine the future population of this city in the year 2040. Use Geometrical Increase method. **07**
 Year: 1970 1980 1990 2000 2010
 Population : 31.2 42.3 65.4 82.9 100.5
 (in thousands)
- Q.4** (a) State the different materials used for the construction of sewers. **07**
- (b) A sewer of 0.6m diameter, laid at a gradient of 1 in 400 runs full. Using Crimp and Bruges' formula, calculate the velocity of flow and the discharge. **07**
- OR**
- Q. 4** (a) State the different steps involved in the layout and construction of sewer lines and explain in detail with sketch the setting out. **07**
- (b) Write a brief note on disposal of screenings. **07**
- Q.5** (a) Explain the primary and secondary treatments of waste water. **07**
- (b) What is self cleansing velocity of waste water flow in the sewers? **07**
 What is dry weather flow?
- OR**
- Q.5** Write Short Notes: (Any Four) **14**

- (i) Recirculation ratio.
- (ii) Low cost sanitation.
- (iii) Storage capacity of elevated service reservoirs.
- (iv) Sewer Appurtenances.
- (v) Procedure for determining the capacity (H.P.) of a pump for pumping the waste water.

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GUJARAT TECHNOLOGICAL UNIVERSITY**P.D.D.C. Sem - IV Examination June- 2011****Subject code: X40601****Subject Name: ENVIRONMENTAL ENGINEERING****Date: 02/06/2011****Time: 10.30 am – 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Write your answers briefly and to the point.

- Q.1** (a) Draw a flow diagram of sewage treatment plant for medium sized city and label all the units. **07**
- (b) State the different points for the location of a water treatment plant for surface source water. Why intake works are provided in the water treatment plant? Discuss the design criteria for the same. **07**

- Q.2** (a) What is population forecast? Why it is required in the design of water treatment plant? State the different methods of forecasting future population and describe any one. **07**
- (b) Write a note on variation in demand of water. **07**

OR

- (b) State the different unit processes used to treat the waste water generated through a city and explain in detail aerobic biological unit process. **07**
- Q.3** (a) What is plain sedimentation treatment in water treatment plant? Why it is required? State the theory of plain sedimentation. **07**
- (b) Explain the following terms: **07**

(i) Surface Overflow Rate (SOR); (ii) Surface loading.

In a continuous flow settling tank 2.5 m deep and 30 m long, what flow velocity of water would you recommend for effective removal of 0.02 mm silica particles at 25⁰ C? Specific gravity of silica particle is to be considered as 2.65 and kinematic viscosity of water at 25⁰ C is $0.90 \times 10^{-2} \text{ cm}^2/\text{sec}$.

OR

- Q.3** (a) Explain briefly the sedimentation aided with coagulation in water treatment process. State the properties of common coagulants. **07**
- (b) What is optimum dose of coagulant and how would you find it in the laboratory? **07**

- Q.4** (a) What is grit chamber? Why it is necessary to provide this in the treatment of sewage? Discuss the design criteria of a grit chamber giving its neat sketch. **07**
- (b) How the efficiency of a grit chamber can be expressed? Explain the design criteria of grit chamber by giving its neat and labeled diagram. **07**

A grit chamber is to be designed to handle a sewage flow from a city having population of 50,000 and per capita daily demand of water is 140 liters. Design the grit chamber.

Assume the following:

- (i) Maximum daily demand = 2.5 times the minimum daily demand
- (ii) Detention time = 1 minute
- (iii) Depth of water = 1.2 m
- (iv) Horizontal flow velocity = 20 cm/sec
- (v) Free board = 0.3 m

OR

- Q. 4** (a) What is low cost sanitation system? Describe with the help of a neat sketch the components of a septic tank. **07**
- (b) State the different processes adopted in tertiary waste water treatment plant. **07**

- Q.5** (a) Give the comparison between high rate and conventional trickling filters. **07**
- (b) What are SVI and MLSS? What does indicate a higher value of SVI? How would you overcome this condition at activated sludge plant? **07**

The MLSS concentration in an aeration tank is 2200 mg/l and the sludge volume after 30 minutes of settling in a 1 lit. Imhoff cone is 220 ml. Calculate:

(i) SVI; (ii) Required return sludge and (iii) SS concentration in the recirculated sludge.

OR

- Q.5** Write Short Notes: (Any Four) **14**

- (i) Testing of sewers.
- (ii) Theory of filtration.
- (iii) Sludge digesters.
- (iv) Storage capacity of elevated service reservoirs.
- (v) Flash Mixer.
