Subject Code	Name of the subject	T	P	C	Marks				Total
					Theory		Practical		
					Cont. assess	Final exam	Cont. assess	Final exam	
26472	Sanitary Engineering	2	3	3	40	60	25	25	150

Rationale	Sanitary Engineering is a branch of civil engineering that involves the planning, design, construction and maintenance of sewerage systems. Sewerage system generally refers to the provision of facilities and services for the safe disposal of human urine and faces, discharge from kitchen & wash room and rain water drainage. It also refers to the maintenance of hygienic conditions, through services such as wastewater disposal, sewage treatment & disposal, Sludge treatment & disposal and Solid waste management. Diploma civil engineers are responsible for construction and maintenance of sanitary elements that necessary safe and hygienic environment. Sanitary engineering for the diploma in civil engineering program may cover concept of sewage, sewer & sewerage system, sewer appurtenances, sewage flow through sewers, construction and maintenance of sewerage, Sewage treatment & disposal, sludge treatment & disposal, Solid waste management, biogas and rural sanitation systems. The main objective of this course is to provide knowledge and skill on sanitary engineering to create efficient technical person in these areas.
Learning Outcome (Theoretical)	**After undergoing the subject, students will be able to** 1. Explain Sewage, sullage, sewer and sewerage system. 2. Describe sewage pumps, siphon & inverted siphon. 3. Sketch a process flow diagram of house wastewater drainage. 4. Calculate discharge rates of sewage. 5. Describe gravity sewers. 6 6. Explain techniques of sewer lines testing. 7. State maintenance of sewerage. 8. Design septic tank and soak pit. 9. Explain wastewater sludge treatment process. 10. Describe municipal solid waste, industrial solid waste, hazardous industrial solid waste and medical waste disposal. 11. Explain biogas. 12. Describe ventilated improved pit latrine and pour flush latrine.
Learning Outcome (Practical)	**After undergoing the subject, students will be able to** 1. Make collar Joint of RCC sewer pipes. 2. Connect 4” or 6” plastic pipe with T, Y, and elbow. 3. Make slope of sewer pipes. 4. Build rain water drainage. 5. Build inspection pit. 6. Build septic tank. 7. Build soak pit. 8. Connect basin with drainage line. 9. Setup Water closet. 10. Make water closet connection with septic tank. 11. Build pour flush latrine.

DETAILED SYLLABUS (THEORY)

Sl	Topics with Contents	Class (1 Period)	Final Marks
1.	**Sewage, sewer and sewerage system** 1.1 Define sewage, sullage, sewer and sewerage. 1.2 Classify sewerage system. 1.3 Mention the uses of different sewer pipes according to materials of construction. 1.4 State different types of sewers with bedding. 1.5 Describe different Joint of sewer pipes with sketch. 1.6 List the materials of a sewer joint.	2	4
2.	**Sewer appurtenances** 2.1 Describe various sewer appurtenances with sketches. 2.2 Mention the importance of providing sewer appurtenances. 2.3 List the dominating factors for locating the sewer appurtenances. 2.4 Describe siphon & inverted siphon with sketch and function. 2.5 Mention the requirements of sewage pumps. 2.6 List various types of sewage pumps. 2.7 State the capacity of sewage pump and pumping stations.	3	8
3.	**Flow through sewers** 3.1 Mention the types of sewer. 3.2 State different conditions of flow through a sewer. 3.3 State self-cleansing velocity and grades of sewer. 3.4 Describe the formulas for various kinds of flow of sewage. 3.5 Explain dry weather flow and storm weather flow. 3.6 Calculate the rainfall by Rational method & Empirical method. 3.7 Elucidate the process Flow diagram of house wastewater drainage. 3.8 Discuss different hydraulic elements of discharge of sewage through a sewer. 3.9 Calculate flow rates for sewers using Chezy's formula.	4	9
4.	**Construction and maintenance of sewerage** 4.1 Explain the procedure of laying a sewerage line in a trench. 4.2 Mention different aspects of gravity sewers. 4.3 Interpret Setting- out the gravity sewers. 4.4 State the techniques of testing sewer lines. 4.5 State Surge tank with function. 4.6 State the necessity of sewerage maintenance. 4.7 Describe the procedures to clean and unlock sewerage. 4.8 State different ways of protection for sewerage. 4.9 Describe the methods for ventilating sewers. 4.10 List the materials for construction and maintenance of sewerage line.	4	8
5.	**Sewage treatment and disposal**	6	10

Sl	Topics with Contents	Class (1 Period)	Final Marks
	5.1 Explain the purpose of sewage treatment. 5.2 Outline the stages of sewage treatment. 5.3 Explain the preliminary and secondary treatment with different types. 5.4 Explain the Detritus tanks (grit chambers) & Skimming tanks with sketches. 5.5 Describe treatment process for removing impurities of stages. 5.6 Sketch the layout of a typical sewage treatment plant. 5.7 Describe the vacuum flotation method for removing greases and oils. 5.8 Sketch of a sedimentation tank. 5.9 Design of septic tanks with a soak pit for 20, 50 and 100 users respectively. 5.10 Explain the construction of septic tank and soak pit with sketches.		
6.	**Sludge treatment and disposal** 6.1 List the various sources of sludge. 6.2 Mention the methods for sludge treatment. 6.3 Explain different purposes served by the sludge digestion. 6.4 Distinguish between anaerobic digestion and aerobic digestion. 6.5 Describe the working principles of a vacuum filters and drying beds. 6.6 List the methods of sludge disposal. 6.7 Explain advantages and disadvantages of incinerating sludge.	4	**6**
7.	**Solid waste management** 7.1 Define solid waste management. 7.2 Mention the different types of solid waste. 7.3 Describe the sources of municipal and industrial solid waste. 7.4 Describe the garbage, rubbish and trash. 7.5 List of the hazardous industrial solid waste. 7.6 Describe the medical waste disposal. 7.7 Mention of different steps for collecting and transporting solid waste. 7.8 Explain the steps for disposal of solid waste. 7.9 Sketch the process flow diagram of different steps of solid waste management from generation to disposal. 7.10 Explain how to reduce solid waste generation.	**4**	**6**
8.	**Biogas** 8.1 Explain biogas. 8.2 Describe the construction procedure of a biogas plant with sketch. 8.3 List the materials of biogas plant.	**2**	**3**
9.	**Rural sanitation**	**2**	**3**

Sl	Topics with Contents	Class (1 Period)	Final Marks
	9.1 Mention on site and off site sanitation systems. 9.2Describe the pour flush, simple pit and VIP latrine with sketch. 9.3 Mention the advantages & disadvantages of pour flush latrine. 9.4State the environmental impact of pit latrine and pour flush latrine. 9.5Design a pit latrine for 06 member's family. 9.6Describe the construction procedures of ventilated improved pit latrine and pour flush latrine.		
10.	**Hygiene and sanitation** 10.1 Explain the importance of hygiene. 10.2 Distinguish between hygiene and sanitation. 10.3 Explain integrated approach for water, sanitation and health education.	**1**	3
	Total	**32**	**60**

DETAILED SYLLABUS (PRACTICAL)

Sl.	Experiment Name with procedure	Class (3 Period)	Marks (Continuous)
1.	**Perform a collar Joint of RCC sewers.** 1.1 Collect materials. 1.2 Collect tools and equipment. 1.3 Make collar Joint between two sewers. 1.4 Maintain the record of performed job.	**1**	**2**
2.	**Perform a 4" or 6" dia uPVC pipe line connection with T, Y, and elbow.** 2.1 Collect materials. 2.2 Collect tools. 2.3 Make pipe line connection with T, Y, and elbow. 2.4 Maintain the record of performed job.	**1**	**2**
3.	**Perform laying a sewer pipe with 1:100 slope.** 3.1 Collect materials. 3.2 Collect tools. 3.3 Make slope. 3.4 Perform laying sewer pipes. 3.5 Maintain the record of performed job.	**1**	**2**
4.	**Perform rain water drainage line from roof to municipal drain.** 4.1 Collect materials. 4.2 Collect tools. 4.3 Joint pipe and make connection with drainage. 4.4 Maintain the record of performed job.	**1**	**2**
5.	**Perform basin connection with drainage.**	**2**	**3**

Sl.	Experiment Name with procedure	Class (3 Period)	Marks (Continuous)
	5.1 Collect materials. 5.2 Collect tools. 5.3 Assemble Basin. 5.4 Joint pipe and make connection with drainage. 5.5 Maintain the record of performed job.		
6.	**Build an inspection pit.** 6.1 Collect materials. 6.2 Collect tools. 6.3 Perform earth works. 6.4 Build inspection pit. 6.5 Maintain the record of performed job.	**2**	**2**
7.	**Build a 2-chamber septic tank.** 7.1 Collect materials. 7.2 Collect tools. 7.3 Perform earth works. 7.4 Build septic tank. 7.5 Maintain the record of performed job.	**3**	**4**
8.	**Build a soak pit and connect with septic tank.** 8.1 Collect materials. 8.2 Collect tools. 8.3 Perform earth works. 8.4 Build soak pit. 8.5 Connect the soak pit with septic tank. 8.6 Maintain the record of performed job.	**2**	**3**
9.	**Perform water closet connection with septic tank.** 9.1 Collect materials. 9.2 Collect tools. 9.3 Assemble water closet. 9.4 Joint pipe and make connection with septic tank. 9.5 Maintain the record of performed job.	**1**	**2**
10.	**Build a pour flush latrine.** 10.1 Collect materials. 10.2 Collect tools. 10.3 Perform earth works. 10.4 Make a pit. 10.5 Build a latrine. 10.6 Maintain the record of performed job.	**2**	**3**
	Total	**16**	**25**

NECESSARY RESOURCES (TOOLS, EQUIPMENT'S AND MACHINERY):

Sl	Experiment Name with Tools and Equipment's	Quantity
01	**Perform a collar Joint of RCC sewers.** Hammer	As per

Sl	Experiment Name with Tools and Equipment's	Quantity
	Wire brush Shovel Spade Lever Jute Measuring Tape Sprit level Try-square	requirements
02	**Perform a 4" or 6" dia uPVC pipe line connection with T, Y, and elbow.** Hammer Shovel Spade Chisel Measuring Tape Plumb bob	As per requirements
03	**Laying a sewer pipe with 1:100 slope.** Hammer Wire brush Shovel Spade Level with tripod Leveling staff Measuring Tape Plumb bob Sprit level Try-square	As per requirements
04	**Perform rain water drainage from roof to municipal drain.** Hammer Shovel Spade Chisel Measuring Tape Plumb bob Sprit level Try-square	As per requirements
05	**Perform basin connection to drainage.** Hammer Shovel Spade Chisel Measuring Tape Slide range Plumb bob Sprit level Try-square	As per requirements
06	**Build an inspection pit.** Hammer	As per

Sl	Experiment Name with Tools and Equipment's	Quantity
	Brick cutter Corny Spade Chisel Measuring Tape Pan Usha Plumb bob Sprit level Try-square	requirements
07	**Build a 2-chambers septic tank.** Hammer Brick cutter Corny Spade Chisel Measuring Tape Pan Usha Plumb bob Sprit level Try-square	As per requirements
08	**Build a soak pit and connect with septic tank.** Hammer Brick cutter Corny Spade Chisel Measuring Tape Pan Usha Plumb bob Sprit level Try-square	As per requirements
09	**Perform Water closet connection with septic tank.** Hammer Brick cutter Corny Spade Chisel Measuring Tape Pan Usha Plumb bob Sprit level	As per requirements
10	**Build a pour flush latrine.**	

Sl	Experiment Name with Tools and Equipment's	Quantity
	Hammer Brick cutter Trowel Spade Chisel Measuring Tape Pan Usha Plumb bob Sprit level	As per requirements

NECESSARY MATERIALS:

Sl	Experiment Name with Materials	Quantity
01	**Perform a collar Joint of RCC sewers.** RCC Sewer pipes Cement Sand Coal tar	As per requirements
02	**Perform a 4" or 6" dia upvc pipe line connection with T, Y, and elbow.** 4" or 6" dia pipe T Joint Y Joint Elbow joint Door band Solvent cement (Gum)	As per requirements
03	**Laying a sewer pipe with 1:100 slope.** Sewer pipe	As per requirements
04	**Perform rain water drainage from roof to municipal drain.** 4" or 6" dia pipe T Joint Y Joint Elbow joint Door band Solvent cement (Gum)	As per requirements
05	**Perform basin connection to drainage.** Basin Pillar coke Angle stop coke Lead pipe Basin waste Waste pipe Rowel plug, Screw/Bracket Putty	As per requirements
06	**Build an inspection pit.**	

Sl	Experiment Name with Materials	Quantity
	Manhole cover Brick Cement Sand Aggregate	As per requirements
07	**Build a 2-chambers septic tank.** Manhole cover Brick Cement Sand Aggregate	As per requirements
08	**Build a soak pit and connect with septic tank.** 4” or 6” dia pipe T Joint Y Joint Elbow joint Door band Solvent cement (Gum)	As per requirements
09	**Perform water closet connection with septic tank.** Water closet (Commode) P or S Trap 4” or 6” dia pipe T Joint Elbow joint Door bend Solvent cement (Gum) Rowel plug and screw Vent cowl	As per requirements
10	**Build a pour flush latrine.** Pan type water closet P or S Trap 4” or 6” dia pipe T Joint Elbow joint Door bend Solvent cement (Gum) Rowel plug and screw RCC Ring Manhole cover Vent cowl	As per requirements

REFERENCE:

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2. Water supply and sanitary engineering- SK Husain

3. Water supply and sanitary engineering- Gurcharan Singh
4. Sanitary Engineering and Sanitation" by K.M. Naidu
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6. Sanitary Engineering: Water Supply and Waste Disposal" by R.S. Khanna and N.C. Gupta
7. Sewerage and Sewage Treatment- Harold E. Babbitt and E. Robert Baumann