Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY , BANGALORE-90

COURSE PLAN

Academic Year 2019-20

Program:	B E – Civil Engineering
Semester :	7
Course Code:	15CV71
Course Title:	Municipal and industrial waste water treatment Engineering
Credit / L-T-P:	3/(3:0:0)
Total Contact Hours:	50
Course Plan Author:	PRIYANKASHI K N

Academic Evaluation and Monitoring Cell

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Table of Contents

Note : Remove “Table of Content” before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

15CV71 : Municipal and Industrial waste water Engineering

A. COURSE INFORMATION

1. Course Overview

Degree:	Civil Engineering	Program:	B.E
Year / Semester :	2019/VII	Academic Year:	2018-19
Course Title:	Municipal and Industrial Waste Water Engineering	Course Code:	15CV71
Credit / L-T-P:	04	SEE Duration:	180 Minutes
Total Contact Hours:	50	SEE Marks:	80 Marks
CIA Marks:	20 Marks	Assignment	1 / Module
Course Plan Author:	PRIYANKASHRI K N	Sign	Dt:
Checked By:	SHIVAPRASAD D G	Sign	Dt:
CO Targets	CIA Target : 80 %	SEE Target:	79 %

2. Course Content

Module	Module Content	Teaching Hours	Module Concepts	Blooms Level
1	Introduction, need for sanitation, methods of sewage disposal, types of sewerage systems, dry weather flow, wet weather flow, factors effecting dry and wet weather flow on design of sewerage system, estimation of storm flow, time of concentration flow, material of sewers, shape of sewers, laying and testing of sewers, ventilation of sewers. low-cost waste treatment; oxidation pond, septic tank, Sewer appurtenances, manholes, catch basins, basic principles of house drainage, typical layout plan showing house drainage connections	10	Design of sewerage systems . sewer appurtenances	L5
2	Design of sewers, hydraulic formula for velocity, effects of variation on velocity, regime velocity, design of hydraulic elements for circular sewers for full flow and partial flow conditions, disposal of effluents by dilution, self purification phenomenon, oxygen sag curve, zones of purification, sewage farming, sewage sickness, numerical problems on disposal of effluents, Streeter-Phelps equation	10	Design of different unit operations	L3
3	Waste water characteristics, sampling, significance and techniques, physical, chemical and biological characteristics, flow diagram for municipal waste water treatment, unit operations; screens, grit chambers, skimming tanks, equalization tanks Suspended growth and fixed film bio process, design of trickling filters, activated sludge process, sequential batch reactors, moving bed bio reactors, sludge digesters	10	Waste water characteristics	L3
4	Difference between domestic and industrial waste water, effect of effluent discharge on streams, methods of industrial waste water treatment; volume reduction, strength reduction, neutralization, equalisation and proportioning. Removal of organic, inorganic and colloidal solids, combined treatment methods;merits, demerits and feasibility, principles of discharge of raw, partially treated and completely treated wastes in to streams	10	conventional and biological treatment process	L2
5	Process flow chart, sources and characteristics of industrial waste water, treatment methods, reuse and recovery and disposal; cotton and textile industry, tanning industry, cane sugar and distilleries, dairy industry, steel and cement industry, paper and pulp industry, pharmaceutical and food processing industry	10	Industrial effluent treatment process	L3

3. Course Material

Module	Details	Available
1	Text books	
a)	K. Subramanya, "Engineering Hydrology".Metcalf and Eddy, "Wastewater Engineering - Collection, Treatment, Disposal and Reuse", McGraw Hill Pub.Co., 2009.	In Lib
b)	Jayarami Reddy, "A Text Book of Hydrology".Nelson Leonard Nemerow, "Industrial Waste Treatment", Butterworth-Heinemann, 2007	
2	Reference books	
a)	H.M. Raghunath, "Hydrology"Manual on Waste Water Treatment : CPHEEO, Ministry of Urban Development, New Delhi	In dept
b)	Sharma R.K., "Irrigation Engineering and Hydraulics".Fair, Geyer and Okun , "Water and Wastewater Engineering" Vol-II, John Willey Publishers, New York	
3	Others (Web, Video, Simulation, Notes etc.)	Not Available

4. Course Prerequisites

SNo	Course Code	Course Name	Module / Topic / Description	Sem	Remarks	Blooms Level
1	15cv71	Municipal and Industrial Waste Water Engineering	-	7	-	
	-	-		-	Plan Gap Course	

Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

B. OBE PARAMETERS

1. Course Outcomes

#	COs	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
co1	Student should be able understand Drainage connection	05	Drainage connection	Lecture	Slip Test	L2 Understand
co.2	Student should be able to understand sewerage network	05	Drainage connection	Lecture	Assignment	L2
co3	Student should be able to understand conventional and biological treatment process	05	biological treatment process	Lecture	Assignment and Slip Test	L4 Analyze
CO4	Student should be able design different treatment unit operation	05	unit operation	Lecture / PPT	Assignment	L3 Apply
CO5	Student should be able to manage sewage effluent issue	05	sewage effluent	Lecture	Slip test	L5
CO6	Student should be able identify waste streams	05	waste streams	Lecture and Tutorial	Assignment	L3
CO7	Student should be able to design sewer with the help of flow of water characteristics	05	water characteristics	Lecture	Assignment and Slip Test	L5 Evaluate
CO8	Student should be able to design the industrial waste water treatment plant	05	Industrial waste water treatment plant	Lecture	Assignment	L2

CO9	Student able to understand the qualities and properties of waste water	05	reuse and recycle.	Lecture	Assignment	L6 Create
CO10	Student should be able to understand type of treatment for disposal, reuse and recycle.	05	reuse and recycle.	Lecture	Assignment	L6 Create
-	**Total**	**62**	-	-	-	-

Note: Identify a max of 2 Concepts per Module. Write 1 CO per concept.

2. Course Applications

SNo	Application Area	CO	Level
1	Water treatment plant	CO1	L2
2	Waste water indistrial area	CO2	L2
3	sanitation and sewage network	CO3	L2
4	Waste water charactersticks	CO4	L3
5	Design of sewers	CO5	L2

Note: Write 1 or 2 applications per CO.

3. Articulation Matrix

(CO – PO MAPPING)

-	Course Outcomes	Program Outcomes												
#	COs	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO9	PO1 0	PO1 1	PO1 2	Level
15cv71pc.1	Student should be able understand drianage connection	1	-	-	-	-	-	-	-	-	-	-	-	L2
15cv71pc.2	Student should be able to understand sewerage network	-	2	-	-	-	-	-	-	-	-	-	-	L2
15cv71pc.3	Student should be able to understand conventional and biological treatment process	-	-	-	-	2	-		-		-	-	-	L2
15cv71pc.4	Student should be able to manage sewage effuent issue	-	-	-	-	-	-	2	-	-	-		-	L3
15cv71pc.5	Student should be able identify waste streams	-	-	-		2	-	-		-	-	-		L2
15cv71pc.6	Student should be able to design sewere with the help of flow of water characteristics	-	-	3	-	-	-		-	-	2	-	-	L2
15cv71pc.7	Student should be able to understand conventional and biological treatment process	-	-	-	-	2	-		-		-	-	-	L2
15cv71pc.8	Student should be able to manage sewage effuent issue	-	-	-	-	-	-	2	-	-	-		-	L3
15cv71pc.9	Student should be able identify waste streams	-	-	-		2	-	-		-	-	-		L2
15cv71pc.10	Student should be able to design sewere with the help of flow of water characteristics	-	-	3	-	-	-		-	-	2	-	-	L2
		1	2	3	-	2	-	2	-	-	2	-	-	
Note: Mention the mapping strength as 1, 2, or 3														

4. Mapping Justification

Mapping		Justification	Mapping Level
CO	**PO**	Students should have the engineering knowledge on waste water properties	**-**
CO1	PO1	Students should conduct the experiments to give conclusion on waste water treatment	L1

CO2	PO2	Students having the engineering knowledge on types of stresses in water	L3
CO4	PO5	deriving expression for characterstick for different waste water cases	L3
CO6	PO1	Engineering knowledge on types sewer system	L3
CO5	PO2	Identify and analyse the biological treatment	L3
CO6	PO5	Students have the engineering knowledge self purification streams	L3
CO4	PO5	deriving expression for characterstick for different waste water cases	L3
CO6	PO1	Engineering knowledge on types sewer system	L3
CO5	PO2	Identify and analyse the biological treatment	L3
CO6	PO5	Students have the engineering knowledge self purification streams	L3

Note: Write justification for each CO-PO mapping.

5. Curricular Gap and Content

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					
4					
5					

Note: Write Gap topics from A.4 and add others also.

C. COURSE ASSESSMENT

1. Course Coverage

Module #	Title	Teaching Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Sewer system	10	2	-	-	1	1	2	CO1	L3
2	Biological treatment process	10	2	-	-	1	1	2	CO2, CO3	L4,l4
3	Industrial waste water treatment	10	-	2	-	1	1	2	CO4, CO5	L4,l4
4	Selfpurification of streams	10	-	2	-	1	1	2	CO6	L4
5	Estimation of strom flow	10	-	-	4	1	1	2	CO7	L5
-	**Total**	**50**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

Note: Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

2. Continuous Internal Assessment (CIA)

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	15	CO1,CO2,CO3	L3,L4,L4
CIA Exam – 2	15	CO4,CO5, CO6,	L4,L4,L4
CIA Exam – 3	15	CO7	L5
Assignment - 1	05	CO1,CO2,CO3	L3,L4,L4
Assignment - 2	05	CO4,CO5, CO6,	L4,L4,L4
Assignment - 3	05	CO7	L5
Seminar - 1			
Seminar - 2			
Seminar - 3			
Other Activities – define – Slip test		CO1 to Co7	L2, L3, L4 . ..
Final CIA Marks	**20**	**-**	**-**

Note : Blooms Level in last column shall match with A.2 above.

D1. TEACHING PLAN - 1

Module - 1

Title:	Divide and Conquer	Appr Time:	16 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Students are able to find the properties of water by exploration of soil for construction of structures	CO1	L3
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
1	Introduction,Objectives and Importance	C01	L2
2	Stages and Methods of exploration- Test pits, Borings, Geophysical methods	C01	L2
3	stabilization of boreholes	C01	L2
4	Sampling techniques	C01	L2
5	Undisturbed, disturbed and representative samples	C01	L2
6	Geophysical exploration and Bore hole log	C01	L2
7	Drainage methods	C01	L2
8	Dewatering methods	C01	L2
9	estimation of depth of GWT (Hvorslev's method).	C01	L3
10	estimation of depth of GWT (Hvorslev's method).	C01	L3
c	**Application Areas**	**CO**	**Level**
1	Use to find soil properties	CO1	L2
2	Used to determine the depth of ground water table	CO1	L3
d	**Review Questions**	-	-
1	List and explain various types of samplers	CO1	L2
2	Explain seismic refraction method of soil exploration with neat sketch	CO1	L2
3	What are the objectives of subsurface exploration?	CO1	L2
4	Describe with neat sketch wash boring technique to explore the soil?	CO1	L2
5	Explain with neat sketch electrical resistivity method of soil exploration?	CO1	L2
6	List out the methods of dewatering. Explain any two method of dewatering with neat sketch	CO1	L2
7	Indicate with neat sketches, selection of number and depth of boring for various civil engineering projects?	CO1	L2
8	List the methods used for controlling ground water during excavation and explain the electro — osmosis method.	CO1	L2
9	Estimate the ground water level by Hvorslev's method using the data given. Depth up to which water is bailed out is 30m, rise in water level after first day is 2.2m, second day 1.8m and on third day it is 1.5m.	CO1	L3
10	A sampling tube has inner diameter of 70mm and cutting edge of 68mm. its outside diameters are 72 mm and 74mm respectively. Determine area ratio, inside clearance, outside clearance of the sampler. This tube is pushed at the bottom of the borehole to a distance of 580mm with length of sample recorded being 520mm. find the recovery ratio.	CO1	L3
e	**Experiences**	-	-
1		CO1	L2
2			
3			
4		CO3	L3
5			

Module – 2

Title:	Divide and Conquer	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Students are able to analyse the distribution of stress in water under loading	CO3	L4
2	Students are able to analyse the settlement of foundation under loading in cohesive and cohesion-less soil	CO4	L3
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
17	Stress in soil Introduction	CO2	L2
18	Boussinesq's and Westergaard's theory - concentrated load, circular load	CO2	L2
19	rectangular load, equivalent point load method	CO2	L2
20	pressure distribution diagrams and contact pressure	CO2	L3
21	Newmark's chart.	CO3	L2
22	Foundation Settlement	CO3	L2
23	Approximate method for stress distribution on a horizontal plane	CO3	L3
24	Types of settlements and importance	CO3	L2
25	Computation of immediate and consolidation settlement	CO3	L4
26	Computation of immediate and consolidation settlement	CO3	L4
c	**Application Areas**	**CO**	**Level**
1	Ability to draw stress disribution digram for a given load on soil	CO2	L3
2	Ability measure settlement beneath loaded footings on sand and clayey soil	CO3	L4
d	**Review Questions**	-	-
11	Explain with sketches various types of settlements. Comment on the sustainability of these types of settlements and functional utility of the structure	CO2	L2
12	List the components of settlement. Give expressions to calculate each one of them, clearly specifying what the notations stand for.	CO2	L2
13	Explain the basis of construction of New mark's chart and discuss how it is used.	CO2	L2
14	Define isobar. Construct an isobar for a vertical stress of 40kN/m2 when ground surface is subjected to a concentrated load of 1000kN.	CO2	L1,L3
15	A circular area on the ground surface 6m in diameter carries a uniformly distributed load of 150kN/m2 . Calculate the vertical stress at depths of 3m, 6m, 9m and 12m. Also plot the variation of stress with depth.	CO2	L3
16	Derive an expression for vertical pressure under a uniformly loaded circular area along vertical symmetrical axis.	CO2	L2
17	Explain a 2V:1H approximate method to determine stress at a depth Z below the footing of rectangular shape of size B x L.	CO2	L2
18	A structure is supported by ring foundation of outer inner diameters 8m and 5m respectively. If the foundation transmits contact pressure of 200kN/m2, compute the stress 3m below the center of the foundation.	CO3	L3
19	A footing of rectangular shape 6m x 8m is uniformly loaded with 180kN/m2 at the ground level. Newmark's chart of influence factor 0.004 is used to find the stress at a certain depth. It that found that 24 elements of the chart are covered by the loaded area. Determine the stress.	CO3	L3
20	A soft clay layer is 5m thick and lies under newly constructed building. The effective pressure due to overlying strata is 300kN/m and new construction increased the overburden by 120kN/m.If liquid limit is 80%, natural water content of the clay layer is 43% and G=2.70. Dry density of the clay is 18kN/m3.Compute the settlement.	CO3	L3,L4

e	**Experiences**	-	-
1		CO1	L2
2			
3			
4		CO3	L3
5			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	15CV71	Sem:	7	Marks:	30	Time:	75 minutes		
Course:	Municipal and Industrial wastewater Engineering								
-	**-**	**Note: Answer any 2 questions, each carry equal marks.**					**Marks**	**CO**	**Level**
1	a	List and explain various types of samplers					CO1	L2	07
	b	A sampling tube has inner diameter of 70mm and cutting edge of 68mm. its outside diameters are 72 mm and 74mm respectively. Determine area ratio, inside clearance, outside clearance of the sampler. This tube is pushed at the bottom of the borehole to a d istance of 580mm with length of sample recorded being 520mm. find the recovery ratio.					CO1	L3	08
2	a	Explain seismic refraction method of soil exploration with neat sketch					CO1	L2	07
	b	Estimate the ground water level by Hvorslev's method using the data given. Depth up to which water is bailed out is 30m, rise in water level after first day is 2.2m, second day 1.8m and on third day it is 1.5m.					CO1	L3	08
3	a	Explain the basis of construction of Newmark's chart and discuss how it is used.					CO2	L2,L4	07
	b	A footing of rectangular shape 6m x 8m is uniformly loaded with 180kN/m2 at the ground level. Newmark's chart of influence factor 0.004 is used to find the stress at a certain depth. It that found that 24 elements of the chart are covered by the loaded area. Determine the stress.					CO2	L4	08
4	a	Explain with sketches various types of settlements. Comment on the sustainability of these types of settlements and functional utility of the structure					CO3	L2	07
	b	A soft clay layer is 5m thick and lies under newly constructed building. The effective pressure due to overlying strata is 300kN/m and new construction increased the overburden by 120kN/m.If liquid limit is 80%, natural water content of the clay layer is 43% and G=2.70. Dry density of the clay is 18kN/m3.Compute the settlement.					CO3	L3	08

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	15CV71	Sem:	7	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Municipal and Industrial wastewater Engineering						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT15CV001	List and explain various types of samplers	5	CO1	L2
2	1KT15CV004	Explain seismic refraction method of soil exploration with neat sketch	5	CO1	L2
3	1KT15CV015	What are the objectives of subsurface exploration?	5	CO1	L2
4	1KT15CV016	Describe with neat sketch wash boring technique to explore the soil?	5	CO1	L2
5	1KT15CV026	Explain with neat sketch electrical resistivity method of soil exploration?	5	CO1	L2
6	1KT15CV028	List out the methods of dewatering. Explain any two method	5	CO1	L2

		of dewatering with neat sketch			
7	1KT16CV001	Indicate with neat sketches, selection of number and depth of boring for various civil engineering projects?	5	CO1	L2
8	1KT16CV002	List the methods used for controlling ground water during excavation and explain the electro — osmosis method.	5	CO1	L2
9	1KT16CV003	Estimate the ground water level by Hvorslev's method using the data given. Depth up to which water is bailed out is 30m, rise in water level after first day is 2.2m, second day 1.8m and on third day it is 1.5m.	5	CO1	L2
10	1KT16CV004	A sampling tube has inner diameter of 70mm and cutting edge of 68mm. its outside diameters are 72 mm and 74mm respectively. Determine area ratio, inside clearance, outside clearance of the sampler. This tube is pushed at the bottom of the borehole to a distance of 580mm with length of sample recorded being 520mm. find the recovery ratio.	5	CO1	L4
11	1KT16CV005	Explain with sketches various types of settlements. Comment on the sustainability of these types of settlements and functional utility of the structure	5	CO2	L2
12	1KT16CV006	List the components of settlement. Give expressions to calculate each one of them, clearly specifying what the notations stand for.	5	CO2	L2
13	1KT16CV007	Explain the basis of construction of Newmark's chart and discuss how it is used.	5	CO2	L2
14	1KT16CV008	Define isobar. Construct an isobar for a vertical stress of 40kN/m2 when ground surface is subjected to a concentrated load of 1000kN.	5	CO2	L1,L3
15	1KT16CV009	A circular area on the ground surface 6m in diameter carries a uniformly distributed load of 150kN/m2 . Calculate the vertical stress at depths of 3m, 6m, 9m and 12m. Also plot the variation of stress with depth.	5	CO2	L3
16	1KT16CV011	Derive an expression for vertical pressure under a uniformly loaded circular area along vertical symmetrical axis.	5	CO2	L2
17	1KT16CV013	Explain a 2V:1H approximate method to determine stress at a depth Z below the footing of rectangular shape of size B x L.	5	CO2	L2
18	1KT16CV014	A structure is supported by ring foundation of outer inner diameters 8m and 5m respectively. If the foundation transmits contact pressure of 200kN/m2, compute the stress 3m below the center of the foundation.	5	CO3	L3
19	1KT16CV016	A footing of rectangular shape 6m x 8m is uniformly loaded with 180kN/m2 at the ground level. Newmark's chart of influence factor 0.004 is used to find the stress at a certain depth. It that found that 24 elements of the chart are covered by the loaded area. Determine the stress.	5	CO3	L3
20	1KT16CV017	A soft clay layer is 5m thick and lies under newly constructed building. The effective pressure due to overlying strata is 300kN/m and new construction increased the overburden by 120kN/m.If liquid limit is 80%, natural water content of the clay layer is 43% and G=2.70. Dry density of the clay is 18kN/m3.Compute the settlement.	5	CO3	L3,L4

D2. TEACHING PLAN - 2

Module – 3

Title:	Divide and Conquer	Appr Time:	16 Hrs

a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Analyse lateral earth pressure in soil at rest	CO4	L4
2	Analyse the factor of safety against failure of earth slope	CO5	L5
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
1	Active, Passive and earth pressure at rest	C04	L2
2	Rankine's theory for cohesionless soil	C04	L2
3	Rankine's theory for cohesive soil	C04	L2
4	Coulomb's theory	C04	L2
5	Rebhann's and Culmann's graphical construction.	C04	L3,L4
6	Assumptions,	C05	L2
7	infinite and finite slopes, factor of safety	C05	L2
8	use of Taylor's stability charts	C05	L2
9	Swedish slip circle method for C and C-ϕ (Method of slices) soils	C05	L3,L4
10	Fellineous method for critical slip circle	C05	L3,L4
c	**Application Areas**	**CO**	**Level**
1	Compute lateral earth pressure distribution behind earth retaining structures	CO4	L4
2	Ability to estimate factor of safety against failure of earth slopes	CO5	L4
d	**Review Questions**	-	-
1	Explain what is meant by active and passive states of plastic equilibrium with sketch.	CO4	L2
2	Derive an expression for factor of safety for infinite slope	CO4	L2
3	What are the causes of failure slopes	CO4	L2
4	Explain with neat sketches i) Active earth pressure ii) Passive earth pressure iii) earth pressure at rest.	CO4	L2
5	Explain Culmann's graphical method for finding out the active earth pressure.	CO5	L3
6	Define Rebhann's graphical method of finding active pressure on a retaining wall.	CO5	L5
7	what are the assumption and limitations of Rankine and coulomb's earth pressure theories.	CO4	L2
8	Mention the different types of slopes and explain the various causes of slope failure.	CO5	L2
9	Explain method of slice to determine the factor of safety against failure of finite slope.	CO5	L2
10	Derive the equation for finite and Infinite Slopes.	CO5	L2
e	**Experiences**	-	-
1		CO1	L2
2			
3			
4		CO3	L3
5			

Module – 4

Title:	Divide and Conquer	Appr	16 Hrs

		Time:	
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Evaluate bearing capacity of shallow foundation by Terzaghis and B.I.S method		L5
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
1	Types of foundations	CO6	L2
2	determination of bearing capacity by Terzaghi's	CO6	L3
3	determination of bearing capacity by BIS method	CO6	L3
4	Effect of water table	CO6	L2
5	Effect of eccentricity	CO6	L2
6	field methods	CO6	L2
7	plate load test	CO6	L2
8	SPT	CO6	L2
9	Proportioning of shallow foundations- isolated	CO6	L5
10	Proportioning of shallow foundations- combined footings	CO6	L5
c	**Application Areas**	**CO**	**Level**
1	Ability to determine bearing capacity of soil and achieve profiency in proportioning shallow isolated and combined footings for uniform bearing pressure	CO6	L5
d	**Review Questions**	-	-
1	Define ultimate and safe bearing capacity of soil.	CO6	L2
2	Give the Terzaghi's equation for bearing capacity of strip, square, circular and rectangular footing.	CO6	L2
3	Discuss the effect of ground water table on bearing capacity.	CO6	L2
4	Explain plate load test with neat sketches to determine bearing capacity soils.	CO6	L2
5	List the assumptions made in terzaghi's bearing capacity theory.	CO6	L2
6	What is standard penetration test? Explain.	CO6	L2
7	What are the corrections applied to observed N values.	CO6	L2
8	Discuss the proportioning of combined footing.	CO6	L2
e	**Experiences**	-	-
1		CO7	L2
2			
3			
4		CO8	L3
5			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	15CV71	Sem:	7	Marks:	30	Time:	75 minutes
Course:	Municipal and Industrial wastewater Engineering						

-	-	**Note: Answer any 2 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	Explain what is meant by active and passive states of plastic equilibrium with sketch.	05	CO5	L2
	b	An embankment is made of soil having C=25kN/m and φ=20 and unit weight γ=19kN/m . The slope is 1.5H: 1V and has 9m height. Determine the factor of safety along a slip circle passing through toe. The center of slip circle is located at Fellinious angles α=26 0 and β=35 0 . Use method of slices and analyze.	10	CO5	L3,L4
2	a	Derive an expression for factor of safety for infinite slope	05	CO5	L2
	b	A retaining wall is 9.0m high , retains cohesion-less backfill. The top 3m of fill has unit weight γ=18kN/m 3 with φ= 32 0 . The rest has unit weight	10	CO5	L3

		γ=22kN/m 3 with φ= 22 0 . Determine the active earth pressure on the wall and its position.			
3	a	Define i. Safe bearing capacity ii. Allowable bearing capacity	04	CO6	L2
	b	What will be the net safe bearing pressure of sand having φ =36 ^{0} , take effective unit weight of soil as 19kN/m ^{3} i. 1.2m wide strip footing ii. 1.2m wide square footing.	06	CO6	L3
	c	Write a note on how bearing capacity changes with respect to water table level.	05	CO6	L3
4	a	When there is need of combined footing, explain with sketches	05	CO6	L3
	b	Design a square footing to carry a safe load of 2400kN on a sandy soil at a depth of 1.5m below GL with factor of safety of 3. Given γ sat =21kN/m 3 with N c = 25, N q = 34 and N γ = 32. Permissible settlement is 40mm. water table may rise up to the base of the footing.	10	CO6	L4

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	15CV71	Sem:	7	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Municipal and Industrial wastewater Engineering						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT15CV001	Explain Culmann's graphical method for finding out the active earth pressure.	5	CO4	L2
2	1KT15CV004	Define Rebhann's graphical method of finding active pressure on a retaining wall.	5	CO4	L2
3	1KT15CV015	what are the assumption and limitations of Rankine and coulomb's earth pressure theories.		CO4	L2
4	1KT15CV016	Mention the different types of slopes and explain the various causes of slope failure.	5	CO4	L2
5	1KT15CV026	Explain method of slice to determine the factor of safety against failure of finite slope.		CO5	L3
6	1KT15CV028	Derive the equation for finite and Infinite Slopes.		CO5	L5
7	1KT16CV001	Define ultimate and safe bearing capacity of soil.		CO4	L2
8	1KT16CV002	Give the Terzaghi's equation for bearing capacity of strip, square, circular and rectangular footing.		CO5	L2
9	1KT16CV003	Discuss the effect of ground water table on bearing capacity.		CO5	L2
10	1KT16CV004	Explain plate load test with neat sketches to determine bearing capacity soils.		CO5	L2
11	1KT16CV005	List the assumptions made in terzaghi's bearing capacity theory.		CO6	L2
12	1KT16CV006	What is standard penetration test? Explain.		CO6	L2
13	1KT16CV007	What are the corrections applied to observed N values.		CO6	L2
14	1KT16CV008	Discuss the proportioning of combined footing.		CO6	L2
15	1KT16CV009	Write a note on standard penetration test and its corrections.		CO6	L2
16	1KT16CV011	Calculate the ultimate bearing capacity of a 2m wide square footing resting on the ground surface of a sand deposit with the following properties : i) Unit weight 18.6 KN/m3		CO6	L4

		ii) Angle of internal friction 35°. Also calculate UBC of same footing when it is placed at depth of lm below the ground surface. Take Nq = 41.4 , N, = 42.2.			
17	1KT16CV013	Discuss effect of water table on bearing capacity of soil.		CO6	L2
18	1KT16CV014	A square footing placed at a depth of 1m is required to carry a load of 1000kN. Find the required size of footing given the following data : C = 10kN/m2 , Ø = 38° , y = 19kN/m3. For Ø = 38°. Terzaghi's bearing capacity factors are N_c = 61.35 , N2 = 48.93 , N_y = 74.03. Assume water table is at base of footing.		CO6	L4
19	1KT16CV016	A circular footing rests on a pure clay with qu = 270 kN/m^2 at a depth of 1.8m. Determine the diameter of the footing if it has to transmit a load of 720 kN. Assume the bulk unit weight of soil as 181(N/m3 and the factor of safety as 3.		CO6	L4
	1KT17CV416				

D3. TEACHING PLAN - 3

Module – 5

Title:	Divide and Conquer	Appr Time:	16 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Analyse the capacity and efficiency of single and group of piles in cohesive and cohesion-less soil		L4
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
1	Types and classification of piles	CO7	L2
2	single loaded pile capacity in cohesion-less soils by static formula	CO7	L2
3	single loaded pile capacity in cohesive soils by static formula	CO7	L2
4	efficiency of file group	CO7	L4
5	group capacity of piles in cohesion-less soils	CO7	L3
6	group capacity of piles in cohesive soils	CO7	L3
7	negative skin friction	CO7	L2
8	pile load tests	CO7	L2
9	Settlement of piles	CO7	L2
10	under reamed piles (only introductory concepts – no derivation)	CO7	L2
c	**Application Areas**	**CO**	**Level**
1	Capability of estimating load carrying capacity of single and group of piles	CO7	L4
d	**Review Questions**	-	-
1	Classify the pile foundation and explain briefly.	CO7	L2
2	Explain Static formula for the design of piles.	CO7	L2
3	With a neat sketch, explain undereamed piles.	CO7	L2
4	With a neat sketch, Explain Pile load test.	CO7	L2
5	What is meant by Efficiency of piles. Explain felds rule.	CO7	L2
6	Explain Settlement of piles in cohesive and cohesionless soil.	CO7	L2
7	Write a note on classification of piles	CO7	L2
8	Explain negative skin friction in pile foundation	CO7	L2
9	Design a friction pile group to carry a load of 3000 kn including the weight of the pile cap at a site where the soil is uniform clay to a depth of 20m, underlain by rock. Average unconfined compressive strength of the clay is 70 kN/m2. The clay may be assumed to be of normal sensitivity and normally loaded with liquid limit 60%. A factor of safety of 3 is required against shear failure.	CO7	L4

10	A group of nine piles with three piles in a row was driven into soft clay extending from ground level to a great depth. The diameter and length s of the piles were 30cm and 10m respectively. The cohesion C = 35kN/m2. If the piles were spaced at 90cm c/c, compare the bearing load on the pile group on the basis of shear failure criterion for a factor of safety of 2.5. Neglect bearing at the tip of the piles. Take m=0.6 for shear mobilization around each pile.	CO7	L4
11	Explain the factors influencing the selection of depth of foundation.	CO7	L4
	A group of nine piles with three piles in a row was driven into soft clay extending from ground level to a great depth. The diameter and length s of the piles were 30cm and 10m respectively. The cohesion C = 35kN/m2. If the piles were spaced at 90cm c/c, compare the bearing load on the pile group on the basis of shear failure criterion for a factor of safety of 2.5. Neglect bearing at the tip of the piles. Take m=0.6 for shear mobilization around each pile.	CO7	L4
e	**Experiences**	-	-
1		CO10	L2
2			
3			
4		CO9	L3
5			

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	15CV71	Sem:	7	Marks:	30	Time:	75 minutes		
Course:	Municipal and Industrial wastewater Engineering								
-	**-**	**Note: Answer any 2 questions, each carry equal marks.**					**Marks**	**CO**	**Level**
1	a	Write a note on classification of piles					04	CO7	L2
	b	What is meant by efficiency of pile group, explain Feld's rule.					05	CO7	L2
	c	A group of nine piles with three piles in a row was driven into soft clay extending from ground level to a great depth. The diameter and length s of the piles were 30cm and 10m respectively. The cohesion C = 35kN/m2. If the piles were spaced at 90cm c/c, compare the bearing load on the pile group on the basis of shear failure criterion for a factor of safety of 2.5. Neglect bearing at the tip of the piles. Take m=0.6 for shear mobilization around each pile.					06	CO7	L4
2	a	Explain static formula for the design of piles					04	CO7	L2
	b	Draw a typical arrangement of under reamed pile with proportion of diameter of pile, bulb and spacing.					06	CO7	L2
	c	Write a note on pile load test					05	CO7	L2
3	a	Classify the various type of Piles based on material and function.					08	CO7	L2
	b	Explain negative skin friction in pile foundation					07	CO7	L2
4	a	Explain determination of the pile load capacity in detail.					07	CO7	L2
	b	Design a friction pile group to carry a load of 3000 kn including the weight of the pile cap at a site where the soil is uniform clay to a depth of 20m, underlain by rock. Average unconfined compressive strength of the clay is 70 kN/m2. The clay may be assumed to be of normal sensitivity and normally loaded with liquid limit 60%. A factor of safety of 3 is required against shear failure.					08	CO7	L4

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	15CV71	Sem:	7	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Municipal and Industrial wastewater Engineering						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT15CV001	Classify the pile foundation and explain briefly.	5	CO7	L2

2	1KT15CV004	Explain Static formula for the design of piles.	5	CO7	L2
3	1KT15CV015	With a neat sketch, explain undereamed piles.	5	CO7	L2
4	1KT15CV016	With a neat sketch, Explain Pile load test.	5	CO7	L2
5	1KT15CV026	What is meant by Efficiency of piles. Explain felds rule.	5	CO7	L2
6	1KT15CV028	Explain Settlement of piles in cohesive and cohesionless soil.	5	CO7	L2
7	1KT16CV001	Write a note on classification of piles	5	CO7	L2
8	1KT16CV002	Explain negative skin friction in pile foundation	5	CO7	L2
9	1KT16CV003	Design a friction pile group to carry a load of 3000 kn including the weight of the pile cap at a site where the soil is uniform clay to a depth of 20m, underlain by rock. Average unconfined compressive strength of the clay is 70 kN/m2. The clay may be assumed to be of normal sensitivity and normally loaded with liquid limit 60%. A factor of safety of 3 is required against shear failure.	5	CO7	L4
10	1KT16CV004	A group of nine piles with three piles in a row was driven into soft clay extending from ground level to a great depth. The diameter and length s of the piles were 30cm and 10m respectively. The cohesion C = 35kN/m2. If the piles were spaced at 90cm c/c, compare the bearing load on the pile group on the basis of shear failure criterion for a factor of safety of 2.5. Neglect bearing at the tip of the piles. Take m=0.6 for shear mobilization around each pile.	5	CO7	L4
11	1KT16CV005	Explain the factors influencing the selection of depth of foundation.	5	CO7	L4
12	1KT16CV006	A group of nine piles with three piles in a row was driven into soft clay extending from ground level to a great depth. The diameter and length s of the piles were 30cm and 10m respectively. The cohesion C = 35kN/m2. If the piles were spaced at 90cm c/c, compare the bearing load on the pile group on the basis of shear failure criterion for a factor of safety of 2.5. Neglect bearing at the tip of the piles. Take m=0.6 for shear mobilization around each pile.	5	CO7	L4
13	1KT16CV007		5		
14	1KT16CV008				
15	1KT16CV009				
16	1KT16CV011				
17	1KT16CV013				
18	1KT16CV014				
19	1KT16CV016				
20	1KT16CV017				

F. EXAM PREPARATION

1. University Model Question Paper

Course:		Municipal and Industrial wastewater Engineering					Month / Year		May /2019	
Crs Code:		15cv71	Sem:	7	7rks:	100	Time:		180 minutes	
-	**Note**	Answer all FIVE full questions. All questions carry equal marks.						**Marks**	**CO**	**Level**
1	a	Discuss about the importance of sub — soil exploration program.						04	CO1	L2
	b	Explain the method of seismic refraction.						06	CO1	L2
	c	What are the methods available for dewatering? Explain any one method.						06	CO1	L2
		OR								
-	a	Explain the wash boring method, with the help of a neat sketch.						08	CO1	L2
	b	Establish the location of ground water in a clayey strata, water in bore was bailed out to a depth of 10.67m below ground surface and rise of water recorded at 24 hour interval. h1 = 64.0cm , h2 = 57.9cm and h3 = 51.8cm.						08	CO1	L3
2	a	Derive the expressions for vertical stress and shear stress by using Boussinesq's theory. Also compare this theory with Westergaard's theory.						06	CO2	L2
	b	Write a note on pressure distribution diagrams.						04	CO2	L2
	c	A load of 1000KN acts as a point load at the surface of a soil mass. Estimate the stress at a point 3m below and 4m away from the point of						06	CO2	L3

		action of the load of Boussinesq's formula. Compare the value with the result from Westergaard's theory.			
		OR			
-	a	Explain with sketches various types of settlements. Comment on the sustainability of these types of settlements and functional utility of the structure.	08	CO3	L2
	b	A soft clay layer is 5m thick and lies under newly constructed building. The effective pressure due to overlying strata is 300kN/m ^{2} and new construction increased the overburden by 120kN/m ^{2} . If liquid limit is 80%, natural water content of the clay layer is 43% and G=2.70. Dry density of the clay is 18kN/m ^{3} . Compute the settlement.	08	CO3	L3
3	a	Define At rest, Active and Passive Earth pressures.	04	CO4	L2
	b	Explain Rankine's theory for calculating Active pressure in cohesion less soils for no surcharge.	05	CO4	L2
	c	With neat sketch, explain Rebhann's graphical method of finding active earth pressure on a retaining wall	07	CO4	L4
-	a	Explain the causes for a slope failure and list the types of slope failures.	05	CO5	L2
	b	Explain Swedish method of slices of stability analysis of slopes.	05	CO5	L2
	c	c. A 5m deep canal has side slopes of 1:1. The properties of soil are Cu = 20kN/m2, $\emptyset$ = 10° , e = 0.8 and G = 2.8. If Taylor's stability number is 0.108, determine the factor of safety with respect to cohesion when the canal runs full. Also fmd the factor of safety in case of sudden draw down, if the Taylor's stability number for this condition is 0.137.	06	CO5	L4
4	a	Define : i) Ultimate bearing capacity ii) Safe bearing capacity.	04	CO6	L2
	b	Discuss effect of water table on bearing capacity of soil.	06	CO6	L2
	c	A square footing placed at a depth of 1m is required to carry a load of 1000kN. Find the required size of footing given the following data : C = 10kN/m2 , $\emptyset$ = 38° , y = 19kN/m3. For $\emptyset$ = 38°. Terzaghi's bearing capacity factors are N_c = 61.35 , N2 = 48.93 , N_y = 74.03. Assume water table is at base of footing.	06	CO6	L4
-	a	Discuss the proportioning of combined footings.	04	CO6	L5
	b	Explain the following : i) Corrections to SPT 'N' value. ii) Use of plate load test results to calculate bearing capacity of soils.	06	CO6	L2
	c	A circular footing rests on a pure clay with qu = 270 kN/m^2 at a depth of 1.8m. Determine the diameter of the footing if it has to transmit a load of 720 kN. Assume the bulk unit weight of soil as 181(N/m3 and the factor of safety as 3.	06	CO6	L4
5	a	Mention the situations where pile foundation is necessary and explain the classification of piles.	08	CO7	L2
	b	Design a friction pile group to carry a load of 3000 kn including the weight of the pile cap at a site where the soil is uniform clay to a depth of 20m, underlain by rock. Average unconfined compressive strength of the clay is 70 kN/m2. The clay may be assumed to be of normal sensitivity and normally loaded with liquid limit 60%. A factor of safety of 3 is required against shear failure.	08	CO7	L4
-	a	Explain determination of the pile load capacity in detail.	05	CO7	L2
	b	Explain the factors influencing the selection of depth of foundation.	05	CO7	L2
	c	A group of nine piles with three piles in a row was driven into soft clay extending from ground level to a great depth. The diameter and length s of the piles were 30cm and 10m respectively. The cohesion C = 35kN/m2. If the piles were spaced at 90cm c/c, compare the bearing load on the pile group on the basis of shear failure criterion for a factor of safety of 2.5. Neglect bearing at the tip of the piles. Take m=0.6 for shear mobilization around each pile.	06	CO7	L4

2. SEE Important Questions

Course:	Municipal and Industrial wastewater Engineering	Month / Year	May /2018

Crs Code:	15cv71	Sem:	7	Marks:	100	Time:	180 minutes		
	Note	Answer all FIVE full questions. All questions carry equal marks.					-	-	
Module	Qno.	Important Question					**Marks**	**CO**	**Year**
1	1	What is subsurface exploration? What are the objectives of soil exploration?					06	CO1	2015
	2	Explain the method of seismic refraction.					07	CO1	2015
	3	What are the methods available for dewatering?explain any one method					07	CO1	2015
	4	Explain briefly stabilization of bore holes.					06	CO1	2016
	5	Estimate the position of the ground water table from the following data obtained from the field. Depth upto which water is boiled out is 30m. Raise in water levels : on first day 2.2m, second day 1.8m and third day 1.5m.					08	CO1	2017
	6	A sampling tube has inner diameter of 70mm and cutting edge of 68mm. its outside diameters are 72 mm and 74mm respectively. Determine area ratio, inside clearance, outside clearance of the sampler. This tube is pushed at the bottom of the borehole to a distance of 580mm with length of sample recorded being 520mm. find the recovery ratio.						CO1	2017
2	1	Write a note on pressure distribution diagrams.					06	CO2	2015
	2	Derive the expressions for vertical stress and shear stress by using Boussinesq's theory. Also compare this theory with Weste rgaard's theory					08	CO2	2015
	3	A load of 1000KN acts as a point load at the surface of a soil mass. Estimate the stress at a point 3m below and 4m away from the point of action of the load of Boussinesq's formula. Compare the value with the result from Westergaard's theory					06	CO2	2015
	4	Write a note on settlement of footings.					08	CO3	2016
	5	A saturated clay 8m thick underlies a proposed new building. The existing overburden pressure at the centre of clay layer is 300KPa and load due to a new building increase the pressure by 200KPa. The liquid limit of the soil is 75%. Water content of soil is 50%. GS — 2.7. Estimate consolidation settlement.					08	CO3	2016
	6	Discuss the proportion of isolated footing.					06	CO3	2016
	7	Explain construction and uses of Newmarks chart.					06	CO2	2016
3	1	Define At rest, Active and Passive Earth pressures.					06	CO4	2015
	2	Explain Rankine's theory for calculating Active pressure in cohesion less soils for no surcharge.					06	CO4	2015
	3	A soft clay layer is 5m thick and lies under newly constructed building. The effective pressure due to overlying strata is 300kN/m and new construction increased the overburden by 120kN/m.If liquid limit is 80%, natural water content of the clay layer is 43% and G=2.70. Dry density of the clay is 18kN/m3.Compute the settlement.					08	CO4	2016
	4	What are the causes for failure of slopes?					06	CO5	2016
	5	Discuss the Swedish method of slices for a cohesive frictional soil.					08	CO5	2017
	6	An embankment is inclines at an angle of 35˚ and its height is 15m. the angle of shearing resistance is 15˚ and the cohesion intercept is 200KN/m2 . The unit weight of soil is 18.0KN/m3. If Taylor's stability number is 0.06, find the factor of safety with respect to cohesion.					06	CO5	2017
4	1	Define safe bearing capacity, safe bearing pressure and allowable bearing pressure.					06	CO6	2015
	2	Write a note on standard penetration test and its corrections.					08	CO6	2015
	3	Calculate the ultimate bearing capacity of a 2m wide square footing resting on the ground surface of a sand deposit with the following properties : i) Unit weight 18.6 KN/m3 ii) Angle of internal friction 35˚. Also calculate UBC of same footing when it is placed at depth of lm below the ground surface. Take Nq = 41.4 , N, = 42.2.					06	CO6	2015
	4	Discuss effect of water table on bearing capacity of soil.					06	CO6	2016
	5	A square footing placed at a depth of 1m is required to carry a load of					08	CO6	2017

		1000kN. Find the required size of footing given the following data : C = 10kN/m2 , Ø = 38° , y = 19kN/m3. For Ø = 38°. Terzaghi's bearing capacity factors are N_c = 61.35 , N2 = 48.93 , N_y = 74.03. Assume water table is at base of footing.			
	6	A circular footing rests on a pure clay with qu = 270 kN/m^2 at a depth of 1.8m. Determine the diameter of the footing if it has to transmit a load of 720 kN. Assume the bulk unit weight of soil as 181(N/m3 and the factor of safety as 3.	08	CO6	2017
5	1	Explain the factors affecting the choice of foundation.	06	CO7	2015
	2	Write a note on classification of pile foundations.	08	CO7	2015
	3	Explain negative skin friction in pile foundation	06	CO7	206
	4	Explain determination of the pile load capacity in detail.	06	CO7	2016
	5	Design a friction pile group to carry a load of 3000 kn including the weight of the pile cap at a site where the soil is uniform clay to a depth of 20m, underlain by rock. Average unconfined compressive strength of the clay is 70 kN/m2. The clay may be assumed to be of normal sensitivity and normally loaded with liquid limit 60%. A factor of safety of 3 is required against shear failure.	08	CO7	2017
	6	A group of nine piles with three piles in a row was driven into soft clay extending from ground level to a great depth. The diameter and length s of the piles were 30cm and 10m respectively. The cohesion C = 35kN/m2. If the piles were spaced at 90cm c/c, compare the bearing load on the pile group on the basis of shear failure criterion for a factor of safety of 2.5. Neglect bearing at the tip of the piles. Take m=0.6 for shear mobilization around each pile.	06	CO7	2017

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Module-#	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
1	Introduction, need for sanitation, methods of sewage disposal, types of sewerage systems, dry weather flow, wet weather flow, factors effecting dry and wet weather flow on design of sewerage system, estimation of storm flow, time of concentration flow, material of sewers, shape of sewers, laying and testing of sewers, ventilation of sewers.	5	- L1 - L2	L2	- sewage disposal - sewerage systems	- Lecture - -	- Slip Test - -
1	low-cost waste treatment; oxidation pond, septic tank, Sewer appurtenances, manholes, catch basins, basic principles of house drainage, typical layout plan showing house drainage connections	5	- L3 - L4	L4	- Sewer appurtenances - house drainage	- Lecture - Tutorial -	- Assignment - -
2	Design of sewers, hydraulic formula for velocity, effects of variation on velocity, regime velocity, design of hydraulic elements for circular sewers for full flow and partial flow conditions,	5	- L2 - L3	L3	-Design of sewers -	- Lecture -	- Assignment -
2	disposal of effluents by dilution, self purification phenomenon, oxygen sag curve, zones of purification, sewage farming, sewage sickness, numerical	5	- L2 - L2	L2	- sewage farming -	- Lecture -	- Slip Test -

	problems on disposal of effluents, Streeter-Phelps equation				Streeter-Phelps equation		
3	Waste water characteristics, sampling, significance and techniques, physical, chemical and biological characteristics, flow diagram for municipal waste water treatment, unit operations;	5	- L1 - L3	L3	-Waste water characteristics -	- Lecture -	- Slip Test -
3	screens, grit chambers, skimming tanks, equalization tanks Suspended growth and fixed film bio process, design of trickling filters, activated sludge process, sequential batch reactors, moving bed bio reactors, sludge digesters	5	- L3 - L2	L3	- design of trickling filters -sludge digesters	- Lecture - Tutorial -	- Assignment - -
4	Difference between domestic and industrial waste water, effect of effluent discharge on streams, methods of industrial waste water treatment; volume reduction, strength reduction,	5	- L3 - L1	L3	-sewage disposal -	- Lecture - Tutorial -	- Assignment - -
4	neutralization, equalisation and proportioning. Removal of organic, inorganic and colloidal solids, combined treatment methods;merits, demerits and feasibility, principles of discharge of raw, partially treated and completely treated wastes in to streams	5	- L2 - L4	L4	-sewage discharge -waste water treatment methods	- Lecture - Tutorial -	- Assignment - -
5	Process flow chart, sources and characteristics of industrial waste water, treatment methods, reuse and recovery and disposal;	5	- L2 - L2	L2	- reuse and recovery and disposal -	- Lecture - -	- Assignment - -
5	cotton and textile industry, tanning industry, cane sugar and distilleries, dairy industry, steel and cement industry, paper and pulp industry, pharmaceutical and food processing industry	5	- L2 - L2	L2	- paper and pulp industry - pharmaceutical and food processing industry	- Lecture - -	- Assignment - -

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

Module-#	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome **Student Should be able to ...**
A	*I*	*J*	*K*	*L*	*M*	*N*

1	understand sewerage network	understand conventional and biological treatment process	sewer appurtenances	Design of sewerage systems . sewer appurtenances	- Understand - Drainage connection - -	Student should be able understand Drainage connection
1	understand conventional and biological treatment process	design different treatment unit operation	material characteristics	Design of different unit operations	- admixtures -understand sewerage network	Student should be able to understand sewerage network
2	design different treatment unit operation	manage sewage effluent issue	Waste water characteristics	Waste water characteristics	- conventional and biological treatment process -	Student should be able to understand conventional and biological treatment process
2	manage sewage effluent issue	Student should be able identify waste streams	conventional and biological treatment process	conventional and biological treatment process	- Understand - treatment unit operation -	Student should be able design different treatment unit operation
3	Student should be able identify waste streams	design sewer with the help of flow of water characteristics	sewage effluent.	Industrial effluent treatment process	- Understand - sewage effluent - -	Student should be able to manage sewage effluent issue
3	design sewer with the help of flow of water characteristics	design the industrial waste water treatment plant	identify waste streams	water characteristics	- Apply strength of concrete - identify waste streams -	Student should be able identify waste streams
4	design the industrial waste water treatment plant	understand the qualities and properties of waste water	water characteristic swater characteristics	qualities and properties of waste water	- Apply - water characteristics	Student should be able to design sewer with the help of flow of water characteristics
4	understand the qualities and properties of waste water	able to understand type of treatment for disposal,	Properties of Special concrete ..	water characteristics	- Understand - waste water treatment	Student should be able to design the industrial waste water treatment plant
5	able to understand type of treatment for disposal,	Sewage disposal,	Properties of Special concrete ..	qualities and properties of waste water	- Understand - Special Concrete	Student able to understand the qualities and properties of waste water
5	understand the qualities and properties of waste water	able to understand type of treatment for	Properties of Special concrete ..	Sewage disposal,	- Understand - recycle and reuse	Student should be able to understand type of treatment for disposal,

		disposal,				