

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

COURSE TITLE: POLLUTION CONTROL & EFFLUENT TREATMENT (Code: 3340504)

Diploma Programme in which this course is offered	Semester in which offered
Chemical Engineering	4 th Semester

1. RATIONALE

Study of environmental pollution, related to the chemical industry is must to understand various types of pollutions and its preventive and control majors. The study of this course would help engineers in operating diverse pollution control equipments for controlling gaseous, water and land pollution. They have to perform sampling and analysis of samples from various sources in the industry. Hence the course has been designed to develop this competency and its associated cognitive, practical and affective domain learning outcomes.

2. COMPETENCY

The course should be taught and curriculum should be implemented with the aim to develop required skills so that students are able to acquire following competency:

- **Perform sampling, analysis and treatment of pollutants to control pollution**

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Define & classify pollution and pollutant - (Air , Water , solid)
- Describe removal of pollutants by applying various treatment methods
- Identify Sources of Pollution
- Conduct Environmental audit and ISO 14001

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
3	0	2	5	70	30	20	30	

Legends: L -Lecture; T -Tutorial/Teacher Guided Student Activity; P -Practical; C - Credit; ESE-End Semester Examination; PA -Progressive Assessment

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Basics of Environmental Pollution	1a. Define pollution and pollutant	1.1 Introduction of pollution and pollutants
	1b. Classify pollutants & pollution	1.2 Types of pollution and pollutants
	1c. Identify Sources of Pollution	1.3 Sources of air, water, noise, radioactive and land pollution
	1d. Explain Effect of pollution	1.4 Effects of air, water, noise, radioactive and land pollution
Unit – II Air Pollution	2a. Explain Sampling of air pollutants	2.1 Ambient air sampling
	2b. Distinguish gaseous and particulate pollutants	2.2 Sampling of gaseous air pollutants and particulate pollutants
	2c. Describe Construction and working of Particulate control equipments	Particulate control equipments 2.3 Gravity Settling Chamber, Cyclone separator, Fabric Filter, Wet Scrubber and Electrostatic Precipitator
	2d. Describe Thermal incineration 2e. List Methods for control of Sulfur dioxide emission 2f. Apply control methods for gaseous air pollutants from Sulfur. 2g. Apply control methods for gaseous air pollutants from Nitrogen Oxides. 2h. Apply control methods for carbon monoxide 2i. Describe removal of pollutants by applying control methods for hydrocarbons	2.4 Thermal incineration 2.5 Methods for control of Sulfur dioxide emission 2.5.1 Extraction of sulfur from fuels 2.5.2 Hydrodesulphurization of coal 2.5.3 Desulphurization of fuel oils 2.5.4 Desulphurization of flue gases by Dry processes (using metal oxides and activated carbon) and wet processes (wet scrubbing methods) 2.6 Methods for control of Nitrogen Oxides 2.6.1 Absorption of NO _x 2.6.2 Adsorption of NO _x 2.6.3 Catalytic reduction 2.7 Control of carbon monoxide 2.8 Control of hydrocarbons
Unit – III Water Pollution	3a. Explain characteristics of water	characteristics of water 3.1 Dissolved oxygen, BOD, COD, VM, Suspended Matter, Dissolved solids, pH
	3b. Distinguish Waste water sampling methods	3.2 Water sampling methods 3.2.1 Grab sampling 3.2.2 Composite sampling
	3c. Describe removal of pollutants by applying Waste water treatment methods	3.3. Waste water treatment methods 3.3.1 Primary treatment 3.3.1.a Pretreatment 3.3.1.b Sedimentation 3.3.1.c Floatation

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		3.3.2 Secondary treatment 3.3.2.a Aerobic process 3.3.2.b Anaerobic process: Activated sludge process and trickling filter
	3d. Describe removal of pollutants by applying various treatment methods on suspended solids 3e. Describe removal of pollutants by applying various treatment methods on dissolved solids 3f. List treatment methods for dissolved solids 3g. Describe facultative ponds 3h. Explain oxidation and disinfection	3.4 Suspended solids treatment methods 3.4.4 Microstraining 3.4.5 Coagulation 3.4.6 Filtration 3.5 Dissolved solids and treatment methods 3.5.4 Ion exchange 3.5.5 Reverse Osmosis 3.5.6 Electrolysis 3.6 Facultative ponds 3.7 Chemical oxidation/Disinfection
	3i. Explain Sludge processing	3.8 Thickening, Digestion, Conditioning, Dewatering, Oxidation and ultimate sludge removal
	3j. Describe Effluent treatment plant drawing schematic block diagram	3.9 Effluent treatment plant- ETP
	3k. List out norms of GPCB for potable water	3.10 Norms of GPCB for potable water
Unit – IV Solid Waste Management	4a. Define solid waste 4b. Classify solid waste	4.1. solid waste
	4c. Explain all methods of solid Waste Disposal	4.3. Methods of solid waste disposal 4.3.1 Open Dumping 4.3.2 Sanitary Land filling 4.3.3 Incineration 4.3.4 Compositing 4.3.5 Reuse, recovery and recycling
Unit – V Environmental audit and ISO 14001	5a. Describe Procedure for Environmental Audit	5.1 Environmental audit 5.1.1 Procedure for environmental audit
	5b. List ISO 14001 norms 5c. Describe Procedure for applying ISO 14001 norms	5.2 ISO 14001 5.2.1 Benefits of ISO 14001 5.2.2 ISO 14001- Assessment process

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Environmental Pollution	08	06	08	00	14
II	Air pollution	14	04	10	08	22
III	Water pollution	12	04	10	06	20
IV	Solid Waste Management	04	02	03	02	07
V	Environmental audit and ISO 14001	04	02	02	03	07
Total Hrs		42	18	33	19	70

Legends: R = Remember; U= Understand; A= Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED LIST OF EXERCISES / PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

Sr. No.	Unit No.	Practical/Exercise (Outcomes' in Psychomotor Domain)	Approx. Hrs. Required
1	I	Prepare detail charts of various Pollutants and sources of pollution	02
2	II	Remove suspended Impurities from air using cyclone system	02
3	II	Remove suspended Impurities from air using fabric filter	02
4	III	Determine hardness (Temporary and Permanent hardness) of given water sample	02
5	III	Determine COD of the given effluent sample	02
6	III	Measure suspended particles in liquids using Turbidity	02

Sr. No.	Unit No.	Practical/Exercise (Outcomes' in Psychomotor Domain)	Approx. Hrs. Required
		meter	
7	III	Determine hydrogen ion concentration (pH) of sample using pH meter.	02
8	III	Determine BOD of given sample	04
9	III	Determine Dissolved Oxygen in effluent sample	02
10	III	Determine total dissolved solids in given effluent sample using heat treatment	02
11	III	Determine chloride concentration in given effluent sample using heat treatment	02
12	IV	Remove suspended solid by coagulation.	02
13	IV	Prepare chart for treatments of different solid waste	02
14	V	Prepare Environmental Audit report for any Chemical Industry	04
Total Hrs			32

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

- Visit to websites of different manufacturer of effluent treatment equipments and prepare a report.
- Visit to websites of pollution control boards of different states/countries and study their norms and regulations

9. SPECIAL INSTRUCTIONAL STRATEGY (If any)

- Show video film of an ETP and on other pollution control measures.
- Arrange visit to nearby solid waste disposal site/segregation plant/incinerator
- Arrange visit to nearby Pollution Control Board/Effluent treatment plants

10. SUGGESTED LEARNING RESOURCES

A. List of Books

S. No.	Title of Books	Author	Publication
1	Environmental Pollution control	Rao C. S.	New age international Pvt. Limited, 2 nd edition
2	Pollution Control in Process Industries	Mahajan S. P.	Tata Mc GrawHill, New Delhi, 21 st reprint, 2008
3	Text Book of Environmental Pollution and Control	Dr. Bhatia H. S.	Galgotia Publication, 1 st edition, New Delhi
4	Environmental Engineering	Pandey G. N., Carney G. C.	Tata Mc GrawHill, New Delhi

B. List of Major Equipment/Materials

- i. **Glassware:** Titration set up, crucible, beaker
- ii. **pH meter:** pH range-2.00 to +16.00, Resolution: 0.01, Accuracy: ± 0.02 , mV range: ± 1999 mV, Temperature range: -10 to +105°C
- iii. **Turbidity meter range:** 0 - 10,000 NTU, Principle of Operation- Nephelometric, Ratio (Color Correction): Full Time ON or OFF, Accuracy: $\pm 2\%$ of reading plus 0.01 NTU (0 to 1000 NTU), Response Time: less than 6 seconds, Sample Size: 30 ml
- iv. **Incubator (BOD set up):** Chamber volume: 285.0 ltrs, range : +50°C to 600°C, controller accuracy: ± 0.50 °C set value of temp., PID Control: microprocessor based PID controller
- v. **Cyclone separator:** 20" diameter cyclone dust collector, 3" carbon steel straight wall and a 38" carbon steel cone tapering to an 8" x 8" discharge, 3" inlet and 3" exhaust. Splits in the middle for easy clean out
- vi. **Weighing machine :** Digital min. measurement 1 microgram

C. List of Software/Learning Websites

- i. <http://www.cosmolearning.com/courses/fundamentals-of-environmental-pollution-and-control-401/video-lectures/>
- ii. <http://www.answers.com/topic/air-pollution>
- iii. https://en.wikipedia.org/wiki/Water_pollution
- iv. <http://www.water-pollution.org.uk/causes.html>
- v. <http://www.acsregistrars.com/iso14001.asp>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. N. N. Hansalia**, Lecturer in Chemical Engineering, Government Polytechnic, Rajkot
- **Prof. (Mrs.) K. J. Sareriya**, Lecturer in Chemical Engineering, Government Polytechnic, Rajkot
- **Prof. (Mrs.) Parul K. Patel**, Lecturer in Chemical Engineering, Government Polytechnic, Gandhinagar

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. Abhilash Thakur**, Associate Professor, Dept. of Applied Sciences
- **Prof. Bashirulla Shaik**, Assistant Professor, Dept. of Applied Sciences