GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: FERTILIZER TECHNOLOGY
(COURSE CODE: 3360501)

Diploma Programme in which this course is offered	Semester in which offered
Chemical Engineering	Sixth

1. RATIONALE

Indian economy is dominated by agriculture sector. Synthetic fertilizers are must for producing good crops. Hence it is needed to provide comprehensive and balanced understanding of essential link between chemistry and the synthetic fertilizer industry. It is therefore vital for chemical engineers to understand for each fertilizer product, its flow diagram for Industry production. For this purpose chemical engineers should have skills for arranging treatment, reaction and separation steps in a flow diagram for variety of fertilizers including Nitrogenous fertilizers, Phosphatic fertilizer, Potash Fertilizer, Complex fertilizer and Bio fertilizers is essential. Hence this course is designed to achieve this objective.

2. COMPETENCY

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

- **Supervise the different stages in fertiliser production.**

3. COURSE OUTCOMES (COs)

The theory should be taught and practicals should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain:

i. Use reactions and unit operations steps in manufacturing of various fertilizers
ii. Characterize fertilizers on the basis of different properties.
iii. Identify engineering problems in fertilizer manufacturing.
iv. Handle the fertilizers.
v. Select appropriate synthesis fertilizer.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	0	2	06	70	30	20	30	150

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

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (In Cognitive Domain)	Topics and Sub-topics
Unit – I Overview of Fertilizers	1a. Justify the need for synthetic fertilizer 1b. Categorize fertilizers 1c. Explain role of essential elements for plant growth	1.1 Synthetic fertilizers, Classification of fertilizers 1.2 Role of essential Elements in plant Growth, 1.3 Macro elements and Micro elements
	1d. Select the relevant fertilizers for the different types of crops	1.4 Application of fertilizers considering Nutrient 1.5 Balance and types of crop
Unit – II Nitrogeneous Fertilizers	2a. Describe different properties of Ammonia 2b. Prepare synthesis path for manufacturing synthesis gas 2c. Differentiate various Ammonia converter 2d. Differentiate various Ammonia manufacturing process 2e. Describe the engineering problems of ammonia manufacturing	2.1 Ammonia: Physical, chemical properties and applications 2.2 Synthesis gas by Catalytic partial oxidation Steam Hydrocarbon reforming 2.3 Ammonia converters: Single bed and multi-bed converter 2.4 Manufacturing of ammonia by Linde Ammonia concept process 2.5 M. W. Kellogg process and Haldor Topsoe process 2.6 Storage and Transportation of Ammonia
	2f. Describe various properties of Nitric Acid 2g. Estimate concentration of Nitric acid 2h. Describe the problems in manufacturing of Nitric Acid	2.7 Nitric acid: Chemical, physical properties and applications 2.8 Manufacturing of Nitric Acid by Pressure ammonia oxidation process and Intermediate pressure ammonia oxidation process 2.9 Concentration of Nitric acid by $Mg(NO_3)2$
	2i. Describe various properties of Urea 2j. Describe the major engineering problems of Urea Manufacturing	2.10 Urea : Physical, chemical properties 2.11 Manufacturing of Urea by Stamicarbon's CO_2 stripping process, Montecatini Solution recycle process Toyo-Koatsu total recycle process
	2k. Describe the manufacturing process of Ammonium Nitrate	2.12 Manufacturing of Ammonium nitrate by Prilling process, Ammonium sulphate from Ammonium carbonate and gypsum Ammonium chloride from Ammonium sulphate and sodium chloride

Unit	Major Learning Outcomes (In Cognitive Domain)	Topics and Sub-topics
Unit –III Phosphatic Fertilizer	3a. Describe various physical and chemical properties Phosphorus and Phosphoric acid 3b. Describe the manufacturing process of Phosphorus by Electric furnace method 3c. Describe the manufacturing process of phosphoric acid by Wet Process 3d. Describe the manufacturing Strong Sulphuric Acid Leaching Hydrochloric Acid Leaching Electric Furnace Process	3.1 Physical, chemical properties and applications of Phosphorus and Phosphoric acid 3.2 Manufacturing of elemental phosphorous by Electric furnace method 3.3 Manufacturing phosphoric acid by Wet Process 3.4 Strong Sulphuric Acid Leaching Hydrochloric Acid Leaching Electric Furnace Process
Unit –IV Potassic Fertilizers	4a. Describe physical and chemical properties 4b. Explain manufacturing of Potassium Chloride from sylvinite 4c. Describe the of Preparation of Potassium nitrate, Potassium sulphate	4.1 Physical, chemical properties and uses of Potassium Chloride, Potassium nitrate, Potassium sulphate 4.2 Manufacturing of potassium chloride from sylvinite 4.3 Preparation of Potassium nitrate, Potassium sulphate
Unit –V Complex Fertilizer and Bio Fertilizer	5a. Explain the manufacturing of complex fertilizers with sketches 6a. Justify the need for biofertilizers and its benefits 6b. Describe the Nitrogen fixing and Phosphate solubilising biofertilizers 6c. Explain preparation a biofertilizers	5.1 Manufacturing of NPK, Ammonium Sulphate Phosphate (ASP), Calcium Ammonium Nitrate(CAN) 6.1 Types of Biofertilizers 6.2 Biofertilizers Nitrogen-fixing biofertilizers Phosphate-solubilizing biofertilizers 6.3 Preparation of a biofertilizers

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total
1	Overview of Fertilizers	06	02	04	02	08
2	Nitrogeneous Fertilizers	22	06	09	06	21
3	Phosphatic Fertilizers	10	03	06	03	12
4	Potassic Fertilizers	06	03	05	03	11
5	Complex Fertilizers and Bio Fertilizers	12	06	06	06	18
	TOTAL	56	20	30	20	70

Legends: R = Remember**, U** = Understand**, A=** Apply and above Level (Bloom's revised taxonomy)

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

7. SUGGESTED PRACTICAL / EXERCISES

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 mainly 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.

S. No.	Unit No.	Practical/Exercise (Outcomes in Psychomotor Domain)	Approx. Hours Required
1	I	Prepare chart for fertilizer classification with chemical formula and nutrient content	02
2	I	Estimate nutrient content (% N, %P_2O, % K_2O) in different fertilizers from their chemical formula	02
3	II	Estimate percentage of Nitrogen in Ammonium chloride by substitution method	02
4	II	Estimate percentage of Nitrogen in Ammonium sulfate by substitution method	02
5	II	Estimate percentage of Nitrogen in Ammonium chloride by back titration	02
6	II	Estimate percentage of Nitrogen in Ammonium sulphate by back titration	02
7	II	Analysis of Urea by Formaldehyde method	02
8	II	Estimate percentage of Nitrogen in Ammonium Chloride/Sulphate by Kjeldhal's method	02
9	II	Estimate biuret content in Urea sample by colour comparison	02
10	III	Estimate percentage of Nitrogen in DAP by Formaldehyde method	02
11	III	Estimate percentage of Nitrogen in DAP by Kjeldhal's method	02
12	IV	Prepare potassium sulphate	02
13	IV	Prepare potasium chloride	02
14	V	Estimate ratio from Ammonia to Phosphoric acid in DAP	02
15	V	Prepare potassium nitrate	02

S. No.	Unit No.	Practical/Exercise (Outcomes in Psychomotor Domain)	Approx. Hours Required
16	VI	Prepare bio-fertilizer	02
	Total		**32**

8. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities. These could be individual or group-based.

i. Prepare course/topic based presentations using internet
ii. Make a report on fertiliser plants in India/Gujarat with their capacity of production and technology being used.
iii. Participate in MCQ/Quiz.

9. SPECIAL INSTRUCTIONAL STRATEGY (IF ANY)

i. Show video/animation films about fertilizer production plants.
ii. Arrange Visit to nearby fertilizer production plant
iii. Arrange expert lectures
iv. Arrange MCQ/Quiz arrange in normal term period.

10. SUGGESTED LEARNING RESOURCES

A) Books

S. No.	Title of Book	Author	Publication
1	Dryden's Outlines of Chemical Technology,	M. Gopala Rao Sitting Marshall	Affiliated East West Press (Pvt) Ltd, 3rd Ed., New Delhi
2	Shreve's Chemical Process Industries, 5th edition	Austin G.T.	McGraw Hill publication, New Delhi
3	Chemical Technology -Vol. I and II, 2nd edition	Pandey G.N. and Shukla	Vani Books Company - Hyderabad
4	Biofertilizers in Agriculture, 2nd edition	N. S. Subba Rao	Oxford & IBH Publishing Company, New Delhi 1988

B) Major Equipment / Instrument with Broad Specifications

i. Glassware: Conical flask, burette, pipette, RBF, measuring cylinder, beaker
ii. Glass Assembly: RBF, reaction vessel, condenser, separating vessel
iii. Burner
iv. Weight balance (minimum 0.1gm)
v. Heating and cooling bath
vi. Kjeldhal Assembly

C) Software/Learning Websites

i. http://nptel.ac.in/courses/103107086/4
ii. http://ijset.com/ijset/publication/v1s6/285-291%20IJSET_PK%20JAGA.pdf
iii. www.gses.com/images/pressreleases/Manufacturing-Process-Fertilizer.pdf
iv. http://nzic.org.nz/ChemProcesses/production/1A.pdf
v. http://tnau.ac.in/eagri/eagri50/SSAC222/lec12.pdf
vi. www.fnca.mext.go.jp/bf/bfm/pdf/Biofertilizer_Manual.pdf

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. N. N. Hansalia**, Lecturer in Chemical Engineering, Government Polytechnic, Rajkot
- **Prof. R. P. Hadiya,** Lecturer in Chemical Engineering, Government Polytechnic, Rajkot
- **Prof.Rakesh R Vasava,** Lecturer in Chemical Engineering, Shri K. J. Polytechnic, Bharuch
- **Prof. M. R. Aacharya**, Lecturer in Chemical Engineering, Government Polytechnic, Gandhinagar

Coordinator andFaculty Members from NITTTR Bhopal

- **Dr. Abhilash Thakur**. Associate Professor, Department of Applied Sciences
- **Dr. Joshua Earnest**, Professor, Department of Electrical & Electronics Engineering.