

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BRANCH NAME: CHEMICAL ENGINEERING**

**SUBJECT NAME: Fertilizer Technology**

**SUBJECT CODE: 2180509**

**B.E. 8<sup>th</sup> SEMESTER**

**Type of course:** Chemical Engineering

**Prerequisite:** Basics of Chemical Process Industries and Chemical Technology

## **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, students 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.

## **Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	2	0	5	70	20	10	30	0	20	150

## **Content:**

Sr. No.	Content	Total Hrs	% Weightage
1	<b>Overview of Fertilizer:</b> Synthetic fertilizers, Classification of fertilizers, Role of essential Elements in plant Growth, Macro elements and Micro elements, Application of fertilizers considering Nutrient, Balance and types of crop. Development of fertilizer industry; Fertilizer production and consumption in India; Nutrient contents of fertilizers; Secondary nutrients; Feedstock and raw materials for nitrogenous, phosphatic and potassic fertilizers.	8	14
2	<b>Nitrogenous Fertilizers:</b> <b>Introduction to Ammonia:</b> Physical & chemical properties, applications, Synthesis gas by Catalytic partial oxidation Steam Hydrocarbon reforming, Ammonia converters: Design aspect of Single bed and multi-bed converter, Kellogg process and HaldorTopsoe process, Storage and Transportation of Ammonia. <b>Introduction to Nitric acid:</b> Chemical, physical properties and applications, Manufacturing of Nitric Acid by Pressure ammonia oxidation process and Intermediate pressure ammonia oxidation process, Concentration of Nitric acid by $Mg(NO_3)_2$ .	22	36

	<b>Urea:</b> Physical, chemical properties, Manufacturing of Urea by Stamicarbon's CO <sub>2</sub> stripping process, Toyo-Koatsu total recycle process, Manufacturing of Ammonium nitrate by Prilling process, Ammonium sulphate from Ammonium carbonate and gypsum, Ammonium chloride from Ammonium sulphate and sodium chloride		
<b>3</b>	<b>Potassium Fertilizers:</b> Physical, chemical properties and uses of Potassium Chloride, Potassium nitrate, Potassium sulphate, Manufacturing of potassium chloride from sylvinite, Preparation of Potassium nitrate, Potassium sulphate.	<b>12</b>	<b>25</b>
<b>4</b>	<b>Miscellaneous Fertilizer and Bio Fertilizers:</b> Manufacturing of NPK, Ammonium Sulphate Phosphate (ASP), Calcium Ammonium Nitrate(CAN), Biofertilizers, Types of Biofertilizers, Nitrogen-fixing biofertilizers, Phosphate-solubilizing biofertilizers, Preparation of a biofertilizers	<b>12</b>	<b>25</b>

**Suggested Specification table with Marks (Theory):**

<b>Distribution of Theory Marks</b>					
R Level	U Level	A Level	N Level	E Level	C Level
<b>28</b>	<b>14</b>	<b>28</b>	-	-	-

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's 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.

**Reference Books:**

1. Hand book of Fertilizer Association of India, New Delhi, 1998.
2. Slack A.V., Chemistry & Technology of Fertilizers, Interscience, New York, 1967.
3. M. Gopala Rao & Marshall Sittig, Dryden's Outlines of Chemical Technology, East-West Press, 3<sup>rd</sup> Edition, New Delhi.
4. Austin G. T, Shreve's Chemical Process Industries, 5th edition, Mc. Graw Hill Publications.
5. Pandey & Shukla, Chemical Technology, Volume I & II, 2<sup>nd</sup> Edition, Vani Books Company.
6. N S Subba Rao, Bio fertilizers in Agriculture, Oxford & IBH Publishing Company.

**List of tutorials:**

- Introduction to fertilizers industries.
- Different types of fertilizers.
- Manufacturing process for different nitrogenous fertilizers.
- Manufacturing process for different potassium fertilizers.
- Introduction to bio fertilizers.

**Course Outcome:**

After learning the course the students should be able to:

- Use reactions and unit operations steps in manufacturing of various fertilizers

- Characterize fertilizers on the basis of different properties.
- Identify engineering problems in fertilizer manufacturing.
- Handle the fertilizers.
- Select appropriate synthesis fertilizer.

**List of Open Source Software/learning website:**

- Students can refer to video lectures available on the websites including NPTEL lecture series.
- Students can refer to the CDs available with some reference books for the solution of problems using software/spreadsheets. Students can develop their own programs/spreadsheets for the solution of problems.
- MIT Open course lecture on Equipment design used in fertilizer Technology.

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.