FERTILIZER & AGROCHEMICAL TECHNOLOGY **Course Code : 316305**

Programme Name/s : **Chemical Engineering**
Programme Code : **CH**
Semester : **Sixth**
Course Title : **FERTILIZER & AGROCHEMICAL TECHNOLOGY**
Course Code : **316305**

I. RATIONALE

India is viewed globally as a powerhouse in agriculture. Fertilizers play a crucial role in modern agriculture by providing essential nutrients like nitrogen, phosphorus, and potassium (NPK) to plants, which are vital for healthy growth, increased yields, and improved crop quality. Fertilizers help the soil maintain its nutrient content. The fertilizer industry and agriculture are inseparable. To achieve sustainable development, it is necessary to balance the growth of both agriculture and the industrial sector. Uncontrolled nutrient applications can have adverse effects on ecosystems, resulting in nutrient runoff and water pollution. Fertilizers have economic, environmental, and social benefits when used responsibly in agricultural systems. The students will acquire knowledge about fertilizer manufacturing process and how excessive fertilizer use harms the environment.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Chemical Engineering Students will develop a strong foundation in fertilizer manufacturing processes required to excel in the fertilizer and agrochemical sector.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Enhance the crop yield by using appropriate agrochemicals.
- CO2 - Select the relevant fertilizer for the different types of crops.
- CO3 - Select suitable raw materials for manufacturing of nitrogenous fertilizers.
- CO4 - Outline the different unit operation for Phosphate and Potash Fertilizers.
- CO5 - Analyze the advantages and disadvantages of mixed and biofertilizers.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316305	FERTILIZER & AGROCHEMICAL TECHNOLOGY	FAT	DSE	3	-	2	1	6	3	03	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the function of agrochemicals in protecting plants and enriching soil. TLO 1.2 Explain the difference between herbicides and fungicides in their mode of action. TLO 1.3 Explain the environmental consequences of extensive use of agrochemicals	**Unit - I Agrochemicals.** 1.1 Agrochemicals: History, Basic concept. 1.2 Plant protector Agrochemicals: functions and example of Pesticides: Insecticides, Herbicides, Fungicides, Environmental Impact of Agrochemicals: - Soil degradation, Water pollution and human health. 1.3 Soil supplements Agrochemicals with examples, Environmental Impact of Agrochemicals: - Soil degradation, Water pollution and human health.	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit
2	TLO 2.1 Identify the different types of Chemical Fertilizers. . TLO 2.2 List the different types of Nutrients. TLO 2.3 Differentiate between primary and secondary nutrients TLO 2.4 Explain the environmental consequences of fertilizer use. TLO 2.5 List the fertilizer industry present in India	**Unit - II Introduction to Fertilizer** 2.1 Types of chemical fertilizers: natural or organic sources and synthetic fertilizers with example. 2.2 Primary and secondary nutrients Micro & Macro Nutrients, Physical and chemical properties of nutrients 2.3 Selection of the relevant fertilizer for the different types of crops. 2.4 Fertilizer industry in India.	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Select suitable feedstock for manufacturing of ammonia. TLO 3.2 Draw process flow diagram for manufacturing process of ammonia. TLO 3.3 Describe the manufacturing process of urea. TLO 3.4 State the chemical reaction in manufacturing of ammonium sulphate. TLO 3.5 Describe the physical and chemical properties of ammonium nitrate.	**Unit - III Nitrogenous Fertilizers** 3.1 Fertilizer Feed stock for manufacturing of Ammonia: a) Gaseous feed stock: natural gas, refinery gas and coke oven gas b) Liquid feed stock: Naphtha, heavy fuel oil, LPG and water c)Solid feedstock: Coal, coke, lignite 3.2 Physical and chemical properties and Manufacturing of a) Urea by Bosch-Meiser process b) Ammonium Sulphate by Direct Neutralization, method. c) Ammonium Nitrate by Prilling Process.	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit
4	TLO 4.1 Draw and explain a process flow diagram for manufacturing of Phosphate Fertilizers TLO 4.2 Draw and explain a process flow diagram for manufacturing of Potash Fertilizers. TLO 4.3 Explain the important role of potash in crops.	**Unit - IV Phosphate and Potash Fertilizers** 4.1 Phosphate Fertilizers: Physical and chemical properties and Manufacturing process 0f a) Single Superphosphate b) Triple Superphosphate c) Monoammonium Phosphate (MAP): d) Diammonium Phosphate (DAP): 4.2 Potash Fertilizers Physical and chemical properties and Manufacturing process a) Potassium chloride /muriate of potash (MOP) by froth flotation. b) Potassium sulfate/sulfate of potash (SOP) by Trona method. c)Potassium nitrate/saltpeter	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit
5	TLO 5.1 Draw and explain a process flow diagram for manufacturing of mixed fertilizer. TLO 5.2 Explain the significance of utilizing a blended fertilizer for crops. TLO 5.3 Make a diagram depicting the process flow of CAN through the granulation process. TLO 5.4 Identify merits and demerits of biofertilizers.	**Unit - V Mixed and Bio-fertilizers** 5.1 Introduction: Concept of mixed and biofertilizer with example. 5.2 Physical and chemical properties and Manufacturing process. a) Ammonium Phosphate Sulphate b) Nitrophosphates c) NPK fertilizers d) Calcium Ammonium Nitrate (CAN) by Granulation process. 5.3 Biofertilizers: benefits and types of biofertilizers, homemade method for preparation biofertilizer.	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Develop skills in measuring, mixing, and preparing solutions using common household materials.	1	*Preparation of Natural & Homemade herbicides.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Develop skills in measuring, mixing, and diluting neem oil solutions using appropriate techniques.	2	Preparation of pesticide using neem oil.	2	CO1
LLO 3.1 Develop skills in operating equipment such as a blender, strainer, and spray bottle for precise application.	3	*Preparation of Natural & Homemade Insecticides.	2	CO1
LLO 4.1 Calculate moisture content of given sample	4	*Determination of moisture from compost fertilizer	2	CO2
LLO 5.1 Calculate moisture content of given sample.	5	Determination of moisture from micronutrient.	2	CO2
LLO 6.1 Calculate moisture content of given sample.	6	*Determination of moisture from organic fertilizer.	2	CO2
LLO 7.1 Develop proficiency in titration techniques.	7	*Measurement of alkalinity of given ammonia fertilizer by Versenate (EDTA) method.	2	CO3
LLO 8.1 Use Kjeldahl apparatus to determine total nitrogen content in sample.	8	*Determination of Total Nitrogen content in given urea/Ammonia chloride fertilizer by Kjeldahl Method.	2	CO3
LLO 9.1 Calculate percentage yield of desired product.	9	*Preparation of potassium chloride	2	CO4
LLO 10.1 Calculate percentage yield of desired product.	10	Preparation of potassium nitrate.	2	CO4
LLO 11.1 Develop proficiency in conducting titration-based methods.	11	Measurement of alkalinity of Diammonium phosphate fertilizer by Versenate (EDTA) method.	2	CO4
LLO 12.1 Develop skills in handling acids and performing controlled reactions.	12	*Preparation of Single Superphosphate (SSP) / Triple Superphosphate (TSP)	2	CO4
LLO 13.1 Develop skills in preparing calibration curves and interpreting data.	13	Determination of nitrogen and phosphorus percentage in NPK fertilizer by using UV spectrophotometry.	2	CO5
LLO 14.1 Develop a skill for recycle kitchen waste to produce an eco-friendly biofertilizer.	14	*Preparation of bio-fertilizer from kitchen waste.	2	CO5
LLO 15.1 Calculate key metrics like percentage retained and percentage passing.	15	Determination of particle size distribution of Calcium Ammonium Nitrate with a dry sieving analysis.	2	CO5
LLO 16.1 Calculate the percentage retained on each sieve.	16	*Determination of particle size distribution of NPK with a dry sieving analysis.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Draw the different flowsheets of manufacturing of nitrogenous fertilizers.
- Draw the different flowsheets of manufacturing of phosphatic fertilizers
- Draw the different flowsheets of manufacturing of potash fertilizers
- Make a chart showing the applications of nitrogenous, phosphatic, potassic, mixed and bio-fertilizers.

Micro project

- Visit the nearby village and make a survey related to usage of fertilizers.
- Collect the different fertilizers and prepare a report including name, structure, application, advantages and disadvantages of the fertilizers.
- Prepare a report on Industrial visit to a nearby fertilizer industry.
- Register to Massive Open Online Courses (MOOCs) on Fertilizer Technology and prepare a brief report.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	UV spectrophotometry	13
2	Oven	2
3	Fertilizer Moisture Analyzer-(Analog range1-10 moisture)	3
4	Dry sieving analyzer: Sieve shaker with set of sieves and pan.	4,15,16
5	Digital weighing balance (1gm to 5kg)	All
6	Glass wares (conical flask, volumetric flask, beakers, burette, pipette, glass rod, test tube, measuring cylinders), Desiccator	All
7	Stop Watch (Analogue)	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Agrochemicals.	CO1	5	4	4	4	12
2	II	Introduction to Fertilizer	CO2	6	2	6	4	12
3	III	Nitrogenous Fertilizers	CO3	10	2	4	6	12
4	IV	Phosphate and Potash Fertilizers	CO4	14	2	8	10	20

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
5	V	Mixed and Bio-fertilizers	CO5	10	2	6	6	14
Grand Total				**45**	**12**	**28**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two Class Test of 30 Marks. Each practical will be assessed considering: 60 % weightage to process, 40 % weightage to product. Internal Self Learning Activity for 25 Marks.

Summative Assessment (Assessment of Learning)

- End of Term Theory Examination. End of Term Practical Examination

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	1	-	3	3	-	3			
CO2	3	1	2	3	2	-	3			
CO3	3	-	-	3	2	-	3			
CO4	3	-	-	3	2	-	3			
CO5	3	3	3	3	2	-	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Colling, G.H	Commercial fertilizer	Edn McGraw Hill, New York, 1955,ISBN-2045728/1/G16416
2	Editorial board	Hand Book fertilizer Technology.	The Fertilizer Association of India, New delhi,1977, ISBN- 9781855734616
3	Sauchelli	The chemistry and technology of fertilizer	Reinhold publishing Corp. New York 1980, ISBN-9780278919075
4	Rao, N S Subba	Bio fertilizer in agriculture	Oxford and IBH Publishing Co. New Delhi, ISBN-9788120407916.
5	Richard P. Pohanish	Pesticides and Agricultural Chemicals	William Andrew ISBN:9781455731572, 1455731579

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.treehugger.com/natural-homemade-insecticides-save-your-garden-without-killing-earth-4858819	Insecticides
2	https://theorganicfarmer.org/simple-home-made-organic-pesticides-2/	Organic Pesticides
3	https://www.treehugger.com/homemade-herbicide-kill-weeds-without-killing-earth-4858812	Herbicide
4	https://archive.nptel.ac.in/courses/103/107/103107086/#	Notes on Fertilizer Technology

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students