

Program Name : Diploma in Chemical Engineering
Program Code : CH
Semester : Sixth
Course Title : Fertilizer Technology (Elective-III)
Course Code : 22615

1. RATIONALE

Indian economy is dominated by agriculture sector, it is therefore vital for chemical technologists to understand each fertilizer product, its flow diagram for industry production. For this purpose students should have skills for arranging treatment, reaction, raw materials for variety of fertilizer including Nitrogenous, phosphatic, Potash, and Biofertilizer is essential. Hence this course is designed to achieve this objective.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use fertilizer manufacturing equipment safely.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

- Use the proper micronutrients to improve fertility of soil.
- Use relevant fertilizer on the basis of different properties.
- Select the relevant manufacturing process for phosphatic fertilizers.
- Select the relevant manufacturing process for potassic fertilizers.
- Select proper micro-nutrient to produce bio-fertilizer.

4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | | |
|-----------------|---|---|----------------|--------------------|-----|-----|-----|-----|-------|-----------|-----|-----|-----|-----|-------|----|
| L | T | P | | Theory | | | | | | Practical | | | | | | |
| | | | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | 2 | 5 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 |

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

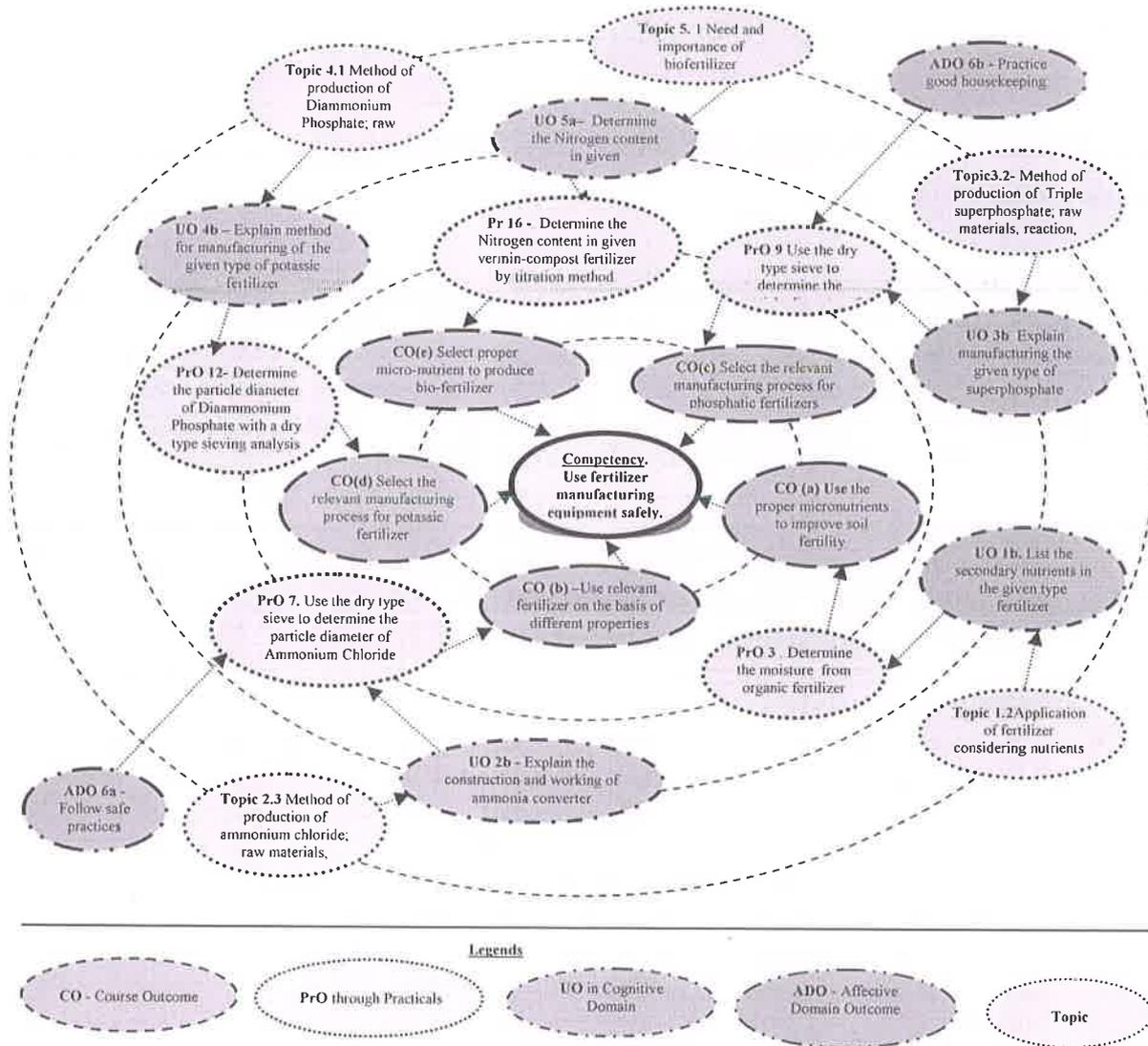


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|--------|---|----------|-----------------------|
| 1 | Determine the moisture from sludge fertilizer. | I | 02* |
| 2 | Determine the moisture from compost fertilizer | I | 02* |
| 3 | Determine the moisture from organic fertilizer | I | 02* |
| 4 | Measure of alkalinity of given Ammonia fertilizer by ethylenediamine tetra acetate method | II | 02 |
| 5 | Determine the particle diameter of calcium Ammonium nitrate with a dry type sieving analysis. | II | 02* |
| 6 | Determine the Nitrogen content in given Ammonium Chloride fertilizer by titration method. | II | 02* |
| 7 | Use the dry type sieve to determine the particle diameter of Ammonium Chloride. | II | 02* |

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|--------------|--|----------|-----------------------|
| 8 | Measure of alkalinity of given single superphosphate fertilizer by ethylenediamine tetra acetate method | III | 02 |
| 9 | Use the dry type sieve to determine the particle diameter of triple superphosphate | III | 02* |
| 10 | Measure of alkalinity of given Diaammonium Phosphate fertilizer by ethylenediamine tetra acetate method. | IV | 02 |
| 11 | Determine the Nitrogen content in given Nitrophosphate fertilizer by titration method. | IV | 02* |
| 12 | Determine the particle diameter of Diaammonium Phosphate with a dry type sieving analysis. | IV | 02* |
| 13 | Determine the particle diameter of NPK with a dry type sieving analysis | IV | 02* |
| 14 | Determine the Nitrogen content in given NPK fertilizer by titration method. | IV | 02* |
| 15 | Measure of alkalinity of given NPK fertilizer by ethylenediamine tetra acetate method | IV | 02* |
| 16 | Determine the Nitrogen content in given vermin-compost fertilizer by titration method. | V | 02 |
| Total | | | 32 |

Note

- i. A suggestive list of practical Los are given in the above table, more such practical Los can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical/tutorials need to be performed, out of which, the practical marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below::

| S. No. | Performance Indicators | Weightage in % |
|--------------|--|----------------|
| a. | Preparation of experimental set up | 20 |
| b. | Setting and operation | 20 |
| c. | Safety measures | 20 |
| d. | Observation and recording | 10 |
| e. | Interpretation of results and conclusion | 10 |
| f. | Answer to sample questions | 10 |
| g. | Submission of report on time | 10 |
| Total | | 100 |

The above PrOs also comprise of the following social skills/ attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/ field based experiences:

- a) Follow safety practices.
- b) Practice good housekeeping.
- c) Practice energy conservation.
- d) Work as a leader/a team member.
- e) Follow ethical Practices.



The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organisation Level' in 2nd year
- 'Characterisation Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

| S. No. | Equipment Name with Broad Specifications | PrO. S. No. |
|--------|---|-------------|
| 1. | pH meter {soil analyzer(9-1),luster Leaf rapitest1880} | 4,8,10,15 |
| 2. | Fertilzer Moisture analyzer –(analog range 1-10 moisture) | 1,2,3 |
| 3. | Thermometer –(soil thermometer 0-120 degree centigrade range) | All |
| 4. | Dry type sieving analyzer.(vibratory sieve shaker,range 20micron-20mm,feed capacity 3kg.) | 5,7,12,13 |
| 5. | Digital Weighing balance—(10grams-5kg capacity) | All |
| 6. | Glass wares (conical flask ,volumetric flask,beaker,Test tube,glass rod) | All |

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|--|---|--|
| Unit – I Overview of fertilizers. | 1a. Explain the importance of given micro nutrients in fertility of soil. 1b. List the secondary nutrients in the given type fertilizer. 1c. List the secondary nutrients in the given type of fertilizer. 1d. Name the location of the given fertilizer industry. | 1.1 Essential elements: Role in plant growth, types and macro and micro elements. 1.2 Importance and applications of fertilizer nutrients. 1.3 Secondary nutrients; feedstock and raw materials for nitrogenous fertilizer. 1.4 Secondary nutrients; phosphatic and potassic fertilizer. 1.5 Development of fertilizer industry in India; fertilizer production and consumption in India |
| Unit– II Nitrogenous fertilizers | 2a State the specified properties of ammonia. 2b Describe with sketches the construction of the given type of converter. 2c Explain with sketches the | 2.1 Introduction to Ammonia; physical and chemical properties, applications, ammonia converter, storage and transportation of Ammonia. 2.2 Method of production of calcium ammonium nitrate; raw materials, |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|--|--|--|
| | <p>working of the given type of converter.</p> <p>2d Explain with flow diagram the manufacturing of the given type of fertiliser.</p> <p>2e Identify proper storage and handling of given type of fertilizer with justification</p> | <p>reaction, flow diagram and applications.</p> <p>2.3 Method of production of ammonium chloride; raw materials, reaction, flow diagram and applications.</p> <p>2.4 Storage and handling of ammonia, calcium ammonium nitrate ammonium chloride fertilizers.</p> |
| Unit III- Phosphatic Fertilizers. | <p>3a. Choose the relevant method for preparation of specified type of superphosphate, with justification</p> <p>3b. Explain manufacturing the given type of phosphate fertiliser.</p> <p>3c. Select proper storage and transportation method for the given type of phosphatic fertilizer.</p> | <p>3.1 Method of production of single superphosphate; raw materials, reaction, flow diagram and application</p> <p>3.2 Method of production of Triple superphosphate; raw materials, reaction, flow diagram and applications.</p> <p>3.3 Storage and handling of superphosphate, fertilizer.</p> <p>3.4 Method of production of Diammonium Phosphate; raw materials, reaction, flow diagram and applications</p> |
| Unit-IV Potassic Fertilizers. | <p>4a. Explain method for manufacturing of the given type of potassic fertilizer</p> <p>4b. Explain with sketches the method for manufacturing of NPK type of fertilizer</p> <p>4c. Identify the devices for storage and handling of potassic fertilizer.</p> | <p>4.1 Method of production of Nitro Phosphate; raw materials, reaction, flow diagram and applications</p> <p>4.2 Method of production of (Mixed fertilizer) NPK fertilizer; raw materials, reaction, flow diagram and applications</p> <p>4.3 Storage and handling of nitro phosphate and NPK fertilizer.</p> |
| Unit –V Bio-fertilizers. | <p>5a. Describe with sketches the construction of the given bio-fertilizer equipment.</p> <p>5b. Explain with sketches the working of the given bio-fertilizer equipment.</p> <p>5c. Identify the merits and demerits given bio-fertilizer unit.</p> <p>5d. Select suitable method to produce the given bio-fertilizer</p> | <p>5.1 Need and importance of bio-fertilizer.</p> <p>5.2 Vermi- Compost; method of preparation and precautions.</p> <p>5.3 Bio-fertilizer; method of preparation by using kitchen waste.</p> <p>5.4 Initiatives and schemes of Central and State Government towards bio-fertilizers.</p> |

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.



9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|--------------|-------------------------|----------------|------------------------------|-----------|-----------|-------------|
| | | | R Level | U Level | A Level | Total Marks |
| I | Overview of fertilizer. | 12 | 04 | 04 | 04 | 12 |
| II | Nitrogenous fertilizers | 12 | 02 | 08 | 08 | 18 |
| III | Phosphatic Fertilizers. | 08 | 02 | 08 | 08 | 18 |
| IV | Potassic Fertilizers | 08 | 02 | 02 | 08 | 12 |
| V | Bio-fertilizers. | 08 | 02 | 04 | 04 | 10 |
| Total | | 48 | 12 | 26 | 32 | 70 |

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

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

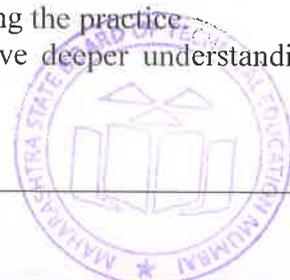
Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a) Prepare journals based on practical performed in laboratory.
- b) Give seminar on relevant topic.
- c) Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

- a) Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- b) '*L*' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c) About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d) With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- e) Guide student(s) in undertaking micro-projects.
- f) Demonstrate students thoroughly before they start doing the practice.
- g) Encourage students to refer different websites to have deeper understanding of the subject.
- h) Observe continuously and monitor the performance of students in Lab.
- i) Demonstrate students thoroughly before they start doing the practice.
- j) Encourage students to refer different websites to have deeper understanding of the subject.



12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

- a) Make working model of vermin compost.
- b) Collect sample of various solid fertilizer with content specification available in market.
- c) Visit nearest bio-fertilizer unit and collect information.
- d) Collect sample of liquid fertilizer available in market and write report.
- e) Make a model for small bio-fertilizer kitchen waste based unit.

13. SUGGESTED LEARNING RESOURCES :

| S. No. | Title of Book | Author | Publication |
|--------|--|-----------------|--|
| 1 | Commercial fertilizer | Colling, G.H | 5 th Edn McGraw Hill, New York, 1955, ISBN-2045728/1/G16416 |
| 2 | Hand Book fertilizer Technology. | Editorial board | The Fertilizer Association of India, New delhi, 1977, ISBN-9781855734616 |
| 3 | The chemistry and technology of fertilizer | Sauchelli | Reinhold publishing Corp. New York 1980, ISBN-9780278919075 |
| 4 | Bio fertilizer in agriculture | Rao, N S Subba | Oxford and IBH Publishing Co. New Delhi, ISBN-9788120407916. |

14. SOFTWARE/LEARNING WEBSITES

- a) Fertilizer Technology.....<https://lecturenotes.in/subject/235/fertilizer-technology-ft>.
- b) Fertilizer Technology.....<https://ifdc.org/fertilizer-technology-developmet>.
- c) Handbook of fertilizer technology—<https://book.google.com/books/about/handbook-on-fertilizer-technology>.



