**UTKALMANI GOPABANDHU INSTITUTE OF ENGINEERING, ROURKELA**

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###### LESSON PLAN

**DEPARTMENT OF CHEMICAL ENGINEERING**

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| LESSON PLANSUBJECT CODE : TH-3 NAME : MO  BRANCH : CH  SEMESTER :Diploma-III CREDIT POINTS : 4 NUMBER OF MODULES : 4 CLASSES REQUIRED : 60 PRE-REQUISITE : To understand working principle of various equipment used for different operations like size reduction, size separation, filtration, mixing, transportation and storage and solve simple problems. |

**MODULE-I**

SIZE REDUCTION 1.1 Objectives of size reduction 1.2 State laws of crushing like Bonds law, Rittinger’s law, Kick’s law 1.3 Crushing efficiency, Work index and solve simple problems based on these laws 1.3 Classification of size reduction equipment and their construction and operation (Jaw crusher, Gyratory crusher, Smooth roll crusher, Hammer Mill, Ball Mill, 1.4 Closed and open circuit grinding, dry and wet grinding, free and choke grinding

**Objectives:**

To understand Objectives of size reduction, laws of crushing like Bonds law, Rittinger’s law, Kick’s law**,** Classification of size reduction equipment.

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| **Lecture no** | **Topics to be covered** | **PRIMARY REFERENCE****(BOOKS/NOTES)** |
| 1 | Objectives of size reduction | R1 |
| 2 | State laws of crushing like Bonds law,  | T1 |
| 3 | State laws of crushing like Rittinger’s law,  | T1 |
| 4 | State laws of crushing like Kick’s law | R1 |
| 5 | Crushing efficiency,work index | R1 |
| 6 | solve simple problems based on Bonds law, | T1, R1 |
| 7 | solve simple problems based on Rittinger’s law | R1 |
| 8 | solve simple problems based on Kick’s law | T1 |
| 9 | solve simple problems based on Crushing efficiency | T1, R1 |
| 10 | solve simple problems based on work index | R1 |
| 11 | Classification of size reduction equipment | T1 |
| 12 | Classification of size reduction equipment | T1, R1 |
| 13 | Jaw crusher | R1 |
| 14 | Gyratory crusher | T1 |
| 15 | Smooth roll crusher | T1, R1 |
| 16 | Hammer Mill | T1, R1 |
| 17 | Ball Mill | R1 |
| 18 | Closed and open circuit grinding | T1 |
| 19 | dry and wet grinding | T1, R1 |
| 20 | free and choke grinding | R1 |

**MODULE-II**

SIZE SEPARATION 2.1 Objectives of size separation 2.2 Shape and size of irregular particle. 2.3 Different types of screen analysis, ideal screen & actual screen, material balance 2.4 Construction and operation of different types of industrial screens and their effectiveness 2.5 Construction and operation of air filters, air separator, cyclone separator, magnetic and Electromagnetic separation 2.6 Theory of settling like free and hindered settling, Stroke’s law, Classification. 2.7 Sedimentation, thickeners, clarifiers, hydraulic classifiers, jigs, classifier riffled table and their use 2.8 Principle & operation of froth floatation and its use.

**Objectives:**

To understand Objectives of size separation, Different types of screen analysis, ideal screen & actual screen, material balance, Theory of settling like free and hindered settling.

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| **Lecture no** | **Topics to be covered** | **PRIMARY REFERENCE****(BOOKS/NOTES)** |
| 21 | Objectives of size separation | T1, R1 |
| 22 | Shape and size of particles | R1 |
| 23 | Different types of screen analysis | T1 |
| 24 | Ideal screen & actual screen | T1, R1 |
| 25 | Material balance | R1 |
| 26 | Construction and operation of different types of industrial screens  | T1 |
| 27 | Industrial screens and their effectiveness | T1, R1 |
| 28 | Industrial screens and their effectiveness | R1 |
| 29 | Construction and operation of air filters, air separator | T1 |
| 30 | Magnetic and Electromagnetic separation | T1, R1 |
| 31 | Theory of settling like free and hindered settling,  | T1, R1 |
| 32 | Stroke’s law, Classification | R1 |
| 33 | Sedimentation, thickeners,  | T1 |
| 34 | Hydraulic classifiers, jigs, classifier  | T1, R1 |
| 35 | Riffled table and their use | R1 |
| 36 | Principle & operation of froth floatation and its use. | T1 |

**MODULE-III**

FILTRATION 3.1 Types of filtrations, Theory of filtration, types of cakes, cake resistance, pressure drop, filter medium, filter Aids and related derivation 3.2 Classification, constructions and working principles of filtration equipments, Thickeners 3.3 Batch and continuous centrifuges with their construction, operation and uses. 3.4 Flocculation, coagulants and role of coagulant in filtration

**Objectives:**

To understand Types of filtrations, Theory of filtration, types of cakes, cake resistance, pressure drop, filter medium, filter Aids and related derivation, Flocculation, coagulants and role of coagulant in filtration**.**

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| **Lecture no** | **Topics to be covered** | **PRIMARY REFERENCE****(BOOKS/NOTES)** |
| 37 | Types of filtrations | T1, R1 |
| 38 | Theory of filtration,  | T1 |
| 39 | Types of cakes, cake resistance, pressure drop,  | T1 |
| 40 | Filter medium, filter Aids and related derivation | R1 |
| 41 | Classification, constructions and working principles of filtration equipments, Thickeners | T1 |
| 42 | Batch centrifuges with their construction, operation and uses | T1, R1 |
| 43 | Continuous centrifuges with their construction, operation and uses | T1, R1 |
| 44 | Flocculation, coagulants and role of coagulant in filtration | R1 |

**MODULE-IV**

MIXING 4.1 Objectives of mixing 4.2 Various mixing operations like (i) Mixing of liquid with liquid (ii) Mixing of liquid with solid (iii) Mixing of viscous materials (iv) Mixing of Solid with solid (v) Mixing of gases with liquids 4.3 The flow pattern in agitated vessel 4.4 Methods of prevention of swirling and vortex formation, baffling 4.5 Different impellers, propellers, paddles used in mixing operation

**Objectives:**

To understand objectives of mixing. To understand various mixing operations, Methods of prevention of swirling and vortex formation.

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| **Lecture no** | **Topics to be covered** | **PRIMARY REFERENCE****(BOOKS/NOTES)** |
| 45 | Objectives of mixing | T1 |
| 46 | Mixing of liquid with liquid | T1 |
| 47 | Mixing of viscous materials | T1 |
| 48 | Mixing of Solid with solid & Mixing of gases with liquids | R1 |
| 49 | Flow pattern in agitated vessels | T1 |
| 50 | Methods of prevention of swirling and vortex formation, baffling | R1 |
| 51 | Different impellers, propellers, paddles used in mixing operation | T1, R1 |
| 52 | Different impellers, propellers, paddles used in mixing operation | R1 |

**MODULE-V**

TRANSPORTATION AND STORAGE 5.1 Objectives of transportation and storage 5.2 Transportation of solid by belt conveyor, apron conveyor, screw Conveyor, bucket elevators, scrapers and pneumatic conveyers 5.3 Storage and handling of solids; construction and uses of silos and bins.

**Objectives:**

To understand objectives of transportation and storage. To understand principle of belt conveyor, apron conveyor, screw Conveyor, bucket elevators, scrapers and pneumatic conveyers.

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| **Lecture no** | **Topics to be covered** | **PRIMARY REFERENCE****(BOOKS/NOTES)** |
| 53 | Objectives of transportation and storage |  |
| 54 | Belt conveyor |  |
| 55 | Apron conveyor | T1, R1 |
| 56 | Screw conveyor | T1 |
| 57 | Bucket conveyor | R1 |
| 58 | Scrapper and pneumatic conveyors | T1 |
| 59 | Storage and handling of solids; construction and uses of silos and bins. | R1 |
| 60 | Storage and handling of solids; construction and uses of silos and bins. | T1, R1 |

**Course Delivery Plan**

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| Week  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| MODULE | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 |

**BOOKS FOR REFERENCE:**

**TEXT BOOKS**

T1: Unit Operation of Chemical Engineering by W.L.Mc.Cabe & J.M.Smith, TMH Publication.

**REFERENCE**

R1: Unit Operation-1 by K A Gavane, NiraliPublication.

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|  | **Prepared by** | **Approved by** |
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| **Designation** | **Lecturer** | **HOD, Chemical.** |
| **Date** |  |  |