

SHIVAJI UNIVERSITY, KOLHAPUR.



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Revised Syllabus For

B. Sc. Part II

Sugar Technology

(Entire)

CBCS PATTERN

Syllabus to be implemented from

June, 2019 onwards.

B. Sc. Part II Sugar Technology

Sem-III

DSC-ST 17: Sugar Engineering (Mill house)

Credit - 1

[15]

Cane handling and preparation

- Cane unloading -Bridge with trolley- having sling bar system-two motion.
- Feeder table-size, slope, chain, breaking strength .power consumption etc.
- Cane carrier-horizontal & inclined carrier length. . Width of carrier, Speed of carrier, capacity of carrier, power consumption of carrier. Type of carrier 1) Split cane carrier.2) Rake carrier, 3) Belt carrier.
- Preparation of cane,
- Various device of cane preparation like chopper, leveler, fiberizer and shredder.
- Measurement of preparation index by bulk density method, sieving method, leaching method.

Credit - 2 [15]

Mills, mill components, mill drive & mill setting

- Conventional mill.
- Mill Headstocks.
- Mill rollers& rollers grooving,
- Messchaert groove,
- Lotus roller,
- Mill hydraulic and loading.
- Mill bearing,
- Mill pinion,
- Trash & Scrapper plate,
- Mill drive- Mill drive power requirement, Prime movers for mills, Mill gearing, Mill couplings and tail bars
- Mill setting-Roller setting, pressure feeder setting; underfeed roller setting, chute opening, trash plate setting, and practical optimization of mill setting.

DSC-ST 18: Sugar Engineering (Boiler and Turbine house)

Credit – 1

[15]

Steam Generation & boiler water treatment

- Properties of steam,
- Fuels (Bagasse) , characteristics of Bagasse, combustion Bagasse,
- Furnaces (Spreader Stoker & Travelling Grate),
- Boiler, Super heater, Economizer, Air preheated,
- Boiler accessories –feed water tank I.D.&F.Dfans Chimney ,electrostatic participator etc.
- Use of condensate.
- Feed water specification and treatment (Internal & External),
- DM & RO Plants, analytical control,
- Boiler Instrumentation & Control.

Credit 02

[15]

Power generation

Turbine

- Classification – description & working of extraction & condensing type turbine
- specific steam consumption

Alternator:

- Sugar factory requirements – size, type, efficiency
- AC generation, and power transmission system

Reference Books

- 1)Hand book of sugar engineering By-H.Eugot
- 2)Hand book of cane sugar By-R.B.L.Mathur
- 3)Cane sugar engineering By-Peter Rein
- 4)Machinery and equipment's of cane sugar factory- By Tromp.

DSC-ST 19: Sugar Manufacturing (Crystallization)**Credit 01****[15]**

- Theory of crystallization & its zones
- Grating & graining methods
- Principals & practices in graining process.
- Mechanism of pan boiling.
- Different massecuite boiling scheme
- Principles and practices in pan boiling
- Construction of pan
- Types of pan
- Pan control & instrumentation.

Credit 02**[15]**

- Cobenze's method for purity control
- Calculations of massecuite %cane & molasses %cane by solid balance
- Determination of crystal %massecuite.
- Determination of crystal size, volume and surface area
- Determination of steam requirement for massecuite boiling
- Crystallization by cooling.
- Type of air and water cooled crystallizers.
- Various zones and their retention time in cooling process.
- Exhaustion of molasses its calculation & various factor affecting exhaustion.

DSC-ST 20: Sugar manufacturing (Centrifugal)

Credit-1

[15]

- Centrifugal theories
- Centrifugal forces
- Mean equivalent radius
- Gravity factor
- Time cycle
- Capacity of basket
- Moment of inertia
- Power required
- Constructions of batch machine ,types of drive and control
- Constructions of continuous machine types of driver and control

Credit- 2

[15]

- Centrifugal operations
- Screen washing
- Sugar washing
- Masecuite charging
- Separation of light and heavy molasses.
- Spinning and drying
- Discharging
- Super heated wash water system
- Drying and cooling of sugar on hopper .fluidized bed drier. Rotary drier
- Grading of sugar, packing of sugar.
- Keeping quality of sugar, storage of sugar
- Specification of sugar as per IS standard.
- Constriction of go down& storage of molasses.

Reference books

- 1)Principle of sugar technology vol I P. Honig
- 2)Principle of sugar technology vol II P. Honig
- 3)Principle of sugar technology vol III P. Honig
- 4)Hand book of sugar refinery chung chi chou
- 5)Manufacturing and refining og raw sugar Baikow
- 6)By product of cane sugar industries Paturau.

DSC-ST 21: Equipment Design (Clarification house)

Credit - 1

[15]

General

- Metals, their properties and uses in sugar industries
- Different type of metals used in sugar industries.
- Metal properties related to engineering/mechanical properties of metal

Juice heaters

- Heat transfer coefficient
- Heating surface.
- Sizing of heater
- Tube size and number of tubes
- No of passes and juice inlet/outlet sizes
- Construction of juice heater.

Credit - 2

[15]

Juice Sulphitor

- Factors used to design continuous juice Sulphitor or reaction tank.
- Lime proportioning device (lime dosing)
- SO₂ gas distribution (SO₂ gas dosing)
- Mechanical stirrer for mixing of reagent
- Design of tank with respect of diameter
- Automation for pH control
- Construction of continuous juice Sulphitor

Sulphur Burners/ Furnace

- Combustion process of sulphur
- Quantity of air required.
- Capacity of sulphur burner.
- Construction of sulphur burner

Juice Clarifier

- Type of clarifier
- Functional theory of operation.
- Retention Time
- Flash Tank.
- Capacity of Clarifier
- Construction of clarifier.

DSC-ST 22: Equipment Design (Evaporation & Crystallization)

Credit – 1

[15]

Evaporator

- Heat transfer & Evaporation coefficient
- Heating Surface
- Tube size and no of tubes
- Juice/syrup inlet-out let connection
- Sizing Triple/Quadruple/Quintuple
- Steam requirement.

Syrup Sulphitor

- Factors used to design syrup Sulphitor
- Design of syrup Sulphitor with respect to diameter.
- Automation for pH control
- Specification and construction of syrup Sulphitor

Credit – 2

[15]

Vacuum Pan

- Type of pan
- Important requirement of pan boiling used to design batch pan.
- Different design of batch pan
- The major design aspects used in continuous pan
- Different design of continuous pan
- Pan capacity and heating surface.
- Construction of pan

Crystallizers

- Type of crystallizers
- Horizontal v/s Vertical crystallizers.
- Capacity of crystallizer
- Various zones and their retention time in cooling process
- Quantity of water required for cooling

Centrifugals

- Type of centrifugal
- Gravity factor
- Type of screen
- Masecuite curing cycle
- DC/AC drive, variable frequency drive
- Capacity of basket.

Hopper & Grader

- Drying & cooling of sugar
- Grading of sugar

References:

- 1) Cane sugar hand book by G.P.Meade & James C.P. Chen
- 2) Hand book of cane sugar engineering by Hugo .
- 3) Manufacturing and refining of raw sugar by Baikow.
- 4) Manufacturing of sugar from sugar cane by G.M.Park.
- 5) Machinery and equipment's of cane sugar factory by L.A.Tromp.
- 6) Unit operation of cane sugar production by Jon .H. Payne

B. Sc. Part II Sugar Technology

Sem-IV

DSC-ST 23: Chemical Engineering-(Heat & Momentum Transfer)

Credit – 1

]15]

Heat transfer

- Conduction- Mechanism of heat transfer by conduction in solids, Fourier's law of heat transfer, Thermal conductivity, and heat loss in conduction. Thermal insulation and optimum thickness for insulation.
- Convection- Heat transfer by convection, forced and natural convection, individual and overall heat transfer coefficient. Fouling factor, overall resistance Effect of drop wise and film wise condensation, , Effect of non-condensable gases.
- Radiation –heat transfer by radiation. Kirchhoff's law , Stefan –Boltzmann law

Heat Transfer Equipment:

- Heater- multipass shell and tube type heat exchanger-shell, tubes, tube pitch ligaments' (clearance), tube passes, Baffles.
- Condenser-types of condenser co-current & counter current.
- Derivation of overall heat transfer coefficient from hot fluid to cold fluid through metal wall

Credit 02

]15]

Fluid Transfer

- Fluid statics- Concept of momentum transfer, Nature of fluid and pressure concept, variation of pressure with height- hydrostatic equilibrium. Barometric equation ,measurement of fluid pressure manometer.
- Fluid flow –types of fluid's ,viscosity of gases and liquids. Types of flow – laminar & turbulent, Reynolds number .Basic equation of fluid flow, Average velocity, and mass velocity.continuity equation, flow of incompressible fluids. Laminar flow through circularconduit, turbulent flow through pipes, friction factor.

Fluid transfer equipment:

- Pumps – positive displacement and centrifugal pumps. Fans, compressor and blower. Metering of fluids - Pipes, Fitting and valves, measurement of liquid and gas flow rates by orifice meter, venture meter, rot meter and Pitot tube.

DSC-ST 24 Chemical engineering-(Unit operation)**Credit 01****Size reduction**

- Necessity& mechanism, Rattling's law, kick's law, Bond's law, method of operating crusher, Size reduction in sugar industries.

Screening

- Standard screens, capacity of screen & efficiency, Ideal and actual screen, screen analysis, equipment for industrial screening, sieve test of sugar.

Leaching& Extraction

- Leaching techniques, perforations through solids bed, stationary bed & moving bed. Counter-current leaching, theory of diffusion. Theory of extraction of juice from cane

Credit – 2**[15]****Sedimentation**

- Law of settling, Stokes law, Batch settling test, Design feature of continuous thickeners, Determination of thickeners area ,factors affecting the settlings rates, Different type of settling equipment .equipments in sugar industries.

Mixing &Agitation

- Introduction, classification of mixing equipment and its application. Mixers for mixing the material. (Solid-solid & solid –liquid)

Filtration

- Theory , factors affecting filtration and remedies, filter aid and their use, equipment used in sugar factory (Rotary vacuum filter,

Centrifugation.

- Theory, different types of centrifugal machines –Batch & continuous, their performance study.

Separation

- Cyclone separation, membrane separation, ultrafiltration & reverse osmosis.

Reference books:

- 1) Introduction of chemical engineering. By Badger and Bane
- 2) Introduction of chemical engineering by Ghosal and Sanyal
- 3) Stoichiometry by Bhatt and Vohra

DSC-ST 25:Capacity Calculation (Clarification house)

Credit – 1

[15]

Capacity of weighing scale and reaction tank.

- Capacity of juice and imbibition's water weighing scale,
- Capacity of raw juice and imbibition's water pumps
- Capacity of reaction tank, calculation of retention time of juice in reaction tank. Calculation for SO₂ gas distribution system

Capacity of Equipment for process chemical

- Calculation of optimum dose of phosphoric acid.
- Capacity of lime preparation equipment with lime pumps.
- Capacity of Sulphur burner and air compressor.

Credit – 2

[15]

Capacity of juice heater

- Calculation of Juice heater capacity
- Calculation of juice velocity in the juice heater.
- Calculation of number tubes and passes in the juice heater.
- Calculation of juice inlet/outlet pipe size. Calculation of steam/vapor pipe size. Calculation of condensate pipe size, calculation of non-condensable gases pipe size. Calculation of tube plate diameter.

Capacity of clarifier.

- Juice retention time in different type of clarifier
- Capacity of clarifier
- Capacity of clear juice pump, capacity of mud pump. Capacity of flash tank, Capacity of rotary vacuum filter.
- Capacity of syrup Sulphitor and syrup pumps.

DSC-ST 26: Capacity calculation (Evaporation & Crystallization house)

Credit – 1 **[15]**

Capacity of Evaporator

- Co-efficient of heat transmit ion,
- Quantity of water evaporated,
- Properties of steam,
- Boiling point elevation.
- Heating surface of evaporator station.
- Calculation of individual Brix
- Calculation of vapor piping.
- Steam requirement without vapor bleeding, steam requirement with vapor bleeding to juice heater and pan.

Vacuum pan

- Optimum S/V ratio of different pan.
- Pan capacity by massecuite %cane method.
- Calculation of heating surface, and number of tubes.
- Pan capacity by solid balance method,
- Calculation of vapor pipe & condensate pipe size capacity of injection pump.

Credit – 2 **[15]**

Centrifugals

- Capacity of cooling crystallizers, quantity of water required for cooling
- Capacity of centrifugal , Capacity of runoff pump.
- Capacity of melter and melt pump
- Capacity of final molasses weighing scale.
- Capacity of superheated wash water system.

Finishing operation

- Capacity of hopper, elevator and grader.
- Capacity of hot and cold air blower
- Capacity of sugar silo.
- Capacity of molasses storage tank,
- Capacity of sugar storage godown

Reference books:

- 1) Introduction of cane sugar technology by Jenkins
- 2) Unit operation of cane sugar production by Jon .H. Payne.
- 3) Manufacturing of sugar from cane sugar by G.M.Park.
- 4) Efficient management in sugar factory.by Mangalsing
- 5) Cane sugar sugar manufacturing in India by D.P.Kulkarni.

DSC-ST 27 Chemical Control (Mill house control)**Credit – 1****[15]**

- Technical definition
- fundamental formula
- Differential method for calculation of Brix %Bagasse, fiber %Bagasse, added water % fiberetc
- Inferential method for calculation of mixed juice% cane, Bagasse %cane, added water %cane etc.
- Clarification of some concepts like java ratio, E.R.Q.V, B.F.C.W.etc

Credit – 2**[15]**

- Primary Extraction
- Secondary Extraction
- Mill Extraction, reduced mill extraction and whole mill extraction
- Control parameters and norms for mill efficiency.

DSC-ST 28: Chemical Control (Boiling house control)

Credit – 1

[15]

- Technical definition
- Basic formulas for daily manufacturing report.

Calculation for run report

- Pol, Brix, Non-sugar balance
- Clarification efficiency & clarification factory.
- stocking & available sugar.
- Boiling house losses.
- Equivalent standard granulated. (ESG)
- Conversion of raw sugar recovery into white sugar recovery by using ESG formula
- Virtual final molasses purity.
- Operation including & excluding stoppage.

Credit - 2

[15]

- Recorded boiling house recovery.
- Theoretical boiling house recovery.
- Ideal boiling house recovery
- Boiling house recovery (ESG)
- Reduced boiling house recovery (GUNDU RAO)
- Overall recovery
- Reduced overall recovery.
- Control parameters and norms for efficiency.

Reference books:

- 1) System of chemical control by S.C.Varma
- 2) Cane sugar hand book by Meade and chan
- 3) Cane sugar hand book by R.B.L.Mathur
- 4) Method of chemical control in cane sugar factory by H.C.PrinsenGeenligs

Practical

DSC STP5-Sugar manufacturing.

- 1) Determination of pol percent cane by Rapi pol extractor.
- 2) Determination of fiber percent cane by Rapi pol extractor
- 3) To find out expected recovery by lab crusher.
- 4) Determination of Cao content in mixed juice and clear juice.
- 5) Determination of P₂O₅ content in mixed juice and clear juice.
- 6) Analysis of final molasses for purity, reducing sugar, total reducing sugar and ash %.
- 7) To determine size of slurry size of seed and size of crystal by microscope.
- 8) Determination of crystal content of massecuite by nutshapparatus/lab centrifugal.
- 9) Determination of viscosity of given sample by digital viscometer.
- 10) Determination of shock lime pH for clarification process.
- 11) Determination of Ash by conductivity meter
- 12) Determination of grade and color by visual method.

DSC STP6: Sugar Engineering

Tutorials and Assignments

DSC STP7: Chemical Control

Tutorials and Assignments

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