SHIVAJI UNIVERSITY, KOLHAPUR - 416 004,
MAHARASHTRA
www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर - ४१६ ००४,महाराष्ट्र
दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९३/९४

Estd. 1962
"A++" Accredited by
NAAC(2021)
With CGPA 3.52

SU/BOS/Science/481 **Date: 01/07/2023**

To,

The Principal, All Concerned Affiliated Colleges/Institutions Shivaji University, Kolhapur	The Head/Co-ordinator/Director All Concerned Department (Science) Shivaji University, Kolhapur.

Subject: Regarding syllabi of B.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of B.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.

B.Sc. Part-II (Sem III & IV) as per NEP-2020			
1.	Mathematics	8.	Chemistry
2.	Statistics	9.	Sugar Technology (Entire)
3.	Physics	10.	Microbiology
4.	Astrophysics	11.	Industrial Microbiology
5.	Zoology	12.	Electronics
6.	Botany	13.	Geology
7.	Plant Protection		

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website **www.unishivaji.ac.in**)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	8	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	9	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	10	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	11	Centre for Distance Education

SHIVAJI UNIVERSITY, KOLHAPUR

CHOICE BASED CREDIT SYSTEM

Syllabus

for

B.Sc. Part-II Sugar Technology (Entire)

(Under Faculty of Science & Technology)

AS PER NEP – 2020

(To be implemented from Academic Year 2023 – 24)

B. Sc. II: Sugar Technology Entire: List of courses:

B. Sc. Part1I (Sem III & IV)

Course Code	Name of Course	Course Code	Name of Course
Sem III		**Sem IV**	
DSCST17	Sugar Engineering (Mill house)	**DSCST23**	Chemical Engineering (Heat & Momentum Transfer)
DSCST18	Sugar Engineering (Boiler and Turbine house)	**DSCST24**	Chemical engineering- (Unit operation)
DSCST19	Sugar Manufacturing (Clarification)	**DSCST25**	Sugar Manufacturing (Crystallization)
DSCST20	Sugar Manufacturing (Evaporation)	**DSCST26**	Sugar Manufacturing (Centrifugal)
DSCST21	Equipment Design (Clarification house)	**DSCST27**	Chemical Control (Mill house control)
DSCST22	Equipment Design (Evaporation & Crystallization)	**DSCST28**	Chemical Control (Boiling house control)
		DSCST29	Environmental Studies

Practical

DSCSTP5	Sugar Manufacturing -II	**DSCSTP6**	Sugar Manufacturing -II
DSCSTP7	Sugar Engineering	**DSCSTP8**	Environmental Studies Project

B.Sc. Part II (Semester III)
Syllabus for Sugar Engineering (Mill house) - DSCST17

UNIT - 1 **[15]**

1.1 - Cane Handling and Feeding:

- 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

1.2 - Cane Preparations:

- Preparation of cane,
- Various device of cane preparation like chopper, leveler, fibrizer & shredder.
- Measurement of preparation index by bulk density method, sieving method, leaching method

UNIT - 2 **[15]**

2.1 - Mills and Mill Components:

- Conventional mill
- Mill Headstocks
- Mill rollers & rollers grooving
- Messchaert groove
- Lotus roller,
- Mill hydraulic and loading
- Mill bearing
- Mill pinion
- Trash & Scrapper plate

2.2 - Mill drives & Mills setting:

- 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, practical optimization of mill setting.

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

B. Sc. Part II (Semester III)
Subject Title: Sugar Engineering (Boiler & Power House) DSCST18

UNIT - 1 **[15]**

1.1 - Steam Generation: (Boiler)

- 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.D fans Chimney, electrostatic participator etc.

1.2 - Boiler Water Treatment:

- Use of condensate
- Feed water specification and treatment (Internal & External),
- DM & RO Plants, analytical control
- Boiler Instrumentation & Control

UNIT - 2 **[15]**

2.1 - Power Generation: (Turbine)

- Classification – description & working of extraction & condensing type turbines
- Specific steam consumption

2.2 – Alternator:

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

Reference Books:

5) Hand Book of Sugar Engineering By- H. Eugot
6) Hand Book of Cane Sugar By-R. B. L. Mathur
7) Cane Sugar Engineering By- Peter Rein
8) Machinery and Equipment's of Cane Sugar Factory- By Tromp

B.Sc. Part II (Semester III)
Syllabus Sugar Manufacturing-I-Clarification - DSCST19

UNIT - 1 **[15]**

1.1 – Introduction:

- Brief account of sugar industry & sugar manufacturing process, Composition of cane & juice, Measuring & weighing of juice, Equipment detail and operation of Maxwell Boulogne scale, magnetic flow meter, Fine bagasse separation and their effect on clarification

1.2 – Reagents:

- Basic chemical required for clarification, their specification, equipment's detail & operation of Milk of lime preparation unit, SO_2 gas production furnace (continuous & film type). Roll of phosphate on clarification & their dose.

UNIT - 2 **[15]**

2.1 – Clarification Process:

- Principle of juice clarification, Details of sulphitation & carbonation process, Equipment detail and operation of reaction tank

2.2 – Equipment:

- Importance of juice heating. Construction and operation of conventional vertical tubular juice heater,
- Principle of settling, Factors affecting settling, Speed of settling, Equipment construction and operation of Dorr multi-feed, Rapi 444, Preparation of settling aid and their dose, Juice and mud removal, preservation of juice during shut down

- Object of filtration, Preparation of mud, Mud – mixer & Bagacillo cyclone, Construction and working of vacuum filter, Mini condenser or vacuum pump, washing of cake, Extraction of light and heavy filtrate

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

B.Sc. Part II (Semester - III)
Syllabus Sugar Manufacturing –II – Evaporation DSCST20

UNIT - 1 **[15]**

1.1 Theory of evaporation:

- Introduction, quantity of water evaporated from juice, Heat transfer in evaporator, Boiling point of juice, Norbert Rilleux principle applicable to multiple effect evaporators

1.2 Construction of Evaporator Body

- Construction of Robert type evaporator, Entrainment and entrainment separator, Condenser and type of condenser, Quantity of water required for condensation, Vapor velocity and vapor piping, other type of evaporator

UNIT - 2 **[15]**

2.1 Operation of evaporator:

- Off season testing of evaporator, Starting of evaporator, Juice level in evaporator, Condensate and non-condensable gas removal, Flash recovery of condensate, Use of condensate, Stopping of evaporator

2.2 Vapor bleeding and steam economy:

- Basic requirement of steam, Steam economy when vapor used for juice heating, Steam economy when vapor used for juice heating and pan boiling, Steam saving device

2.3 Treatment of syrup:

- Construction and working of syrup sulphitor, Scale formation and removal

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

B.Sc. Part II (Semester - III)
Syllabus for Equipment Design – Clarification DSCST21

UNIT – 1 **[15]**

1.1 - Metals, their Properties & Uses in Sugar Industries

- Different type of metals used in sugar industries.
- Metal properties related to engineering/mechanical properties of metal.

1.2 - 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.

1.3 - Sulphur Burners/ Furnace:

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

UNIT– 2 **[15]**

2.1 - Juice Sulphitor :

- Factors used to design continuous juice sulphitor or reaction tank.
- Lime proportioning device (lime dosing**)**
- SO_2 gas distribution (SO_2 gas dosing)
- Mechanical stirrer for mixing of reagent
- Design of tank with respect of diameter
- Automation for pH control
- Construction of continuous juice sulphitor

2.2 - Juice Clarifier

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

2.3 – Filtration:

- Types of filters
- Theory of the filtration
- Mud mixture
- Capacity of vacuum filter
- Construction of vacuum filter

Reference Books:

1) Cane sugar hand book by G. P. Meade & Jamescp. 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 Semester III

Syllabus for Equipment Design (Evaporation & Crystallization) DSCST22

UNIT -1 **[15]**

1.1 – 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.

1.2 - Syrup Sulphitor:

- Factors used to design syrup sulphitor
- Design of syrup sulphitor with respective to diameter.
- Automation for Ph control.
- Specification and construction of syrup sulphitor.

UNIT – 2 **[15]**

2.1 - 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

2.2 – 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

2.3 - Centrifugal:

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

2.4 - Hopper & Grader:

- Drying & cooling of sugar
- Grading of sugar

Reference Books:

1) Cane sugar hand book by G. P. Meade & Jamescp. 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 Semester IV

Subject Title: Chemical Engineering (Heat & Momentum Transfer) DSCST23

UNIT – 1 **[15]**

1.1 - Heat transfer:

- Conduction- Mechanism of heat transfer by conduction in solids, Fourier's low 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.

1.2 - Heat Transfer Equipment:

- Heater – multi-pass 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

UNIT – 2 **[15]**

2.1 - 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 - Type of fluids, 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 circular conduit, turbulent flow through pipes, fraction factor

2.2 - Fluid transfer Equipment:

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

Reference Books:

1) Introduction of Chemical Engineering by Badger and Baneo
2) Introduction of Chemical Engineering by Ghosal and Sanyal
3) Stoichiometry by Bhatt and Vohra

B.Sc. Part II Semester IV

Subject Title: Chemical Engineering (Unit Operation) DSCST24

UNIT – 1 **[15]**

1.1- Size reduction:

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

1.2 – Screening:

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

1.3 - 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.

1.4 - 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, equipment in sugar industries.

UNIT – 2 **[15]**

2.1 – Evaporation:

- Theory of evaporation, construction and operation of evaporator bodies.

2.2 - Mixing & Agitation:

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

2.3 – Filtration:

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

2.4 – Centrifugation:

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

2.5 - Separation

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

Reference Books:

1) Introduction of Chemical Engineering by Badger and Baneo
2) Introduction of Chemical Engineering by Ghosal and Sanyal
3) Stoichiometry by Bhatt and Vohra

B.Sc. Part II Semester- IV
Subject Title: Sugar Manufacturing (Crystallization) DSCST25

UNIT - 1 **[15]**

1.1 - Theory of Crystallization & It's Zones
1.2 - Granting & graining methods
1.3 - Principals & practices in graining process
1.4 - Mechanism of pan boiling
1.5 - Different massecuite boiling scheme
1.6 - Principles and practices in pan boiling
1.7 - Construction of pan
1.8 - Types of pan
1.9 - Pan control & instrumentation.

UNIT - 2 **[15]**

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

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 of raw sugar Baikow
6) By product of cane sugar industries Paturau

B.Sc. Part II Semester- IV
Subject Title: Sugar Manufacturing (Centrifugal) DSCST26

UNIT– 1 **[15]**

1.1 - Centrifugal theories:

- Centrifugal forces
- Mean equivalent radius
- Gravity factory
- Time cycle
- Capacity of basket
- Moment of inertia
- Powered required

1.2- Constructions of batch machine, types of drive and control
1.3- Constructions of continuous machine types of drive and control

UNIT – 2 **[15]**

2.1 - Centrifugal Operations:

- Screen washing
- Sugar washing
- Massecuite charging
- Separation of light and heavy molasses.
- Spinning and drying
- Discharging
- Super heated wash water system

2.2 – Drying, Cooling & Grading:

- Drying and cooling of sugar on hopper, fluidized bed drier, Rotary drier
- Grading of sugar, packing of sugar

2.3 - Keeping quality of sugar in storage

2.4 – Storage of sugar & molasses:

- Specification of sugar as per IS standard.
- Constriction of godown & 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 of raw sugar Baikow
6) By product of cane sugar industries Paturau

B.Sc. Part II Semester- IV
Subject Title: Chemical Control (Mill House) DSCST27

UNIT – 1 **[15]**

1.1 **–** Definition & Formulae:

- Technical definition
- Fundamental formula

1.2 - Differential method for calculation of Brix % Bagasse, fibre % Bagasse, added water % fibre etc.

1.3 - Inferential method for calculation of mixed juice % cane, Bagasse % cane, added water % cane etc.

1.4 - Clarification of some concepts like java ratio, E.R.Q.V, B.F.C.W. etc.

UNIT – 2 **[15]**

2.1 – Extration:

- Primary Extraction
- Secondary Extraction
- Mill Extraction, reduced mill extraction and whole mill extraction.

2.2 - Control parameters and norms for mill efficiency.

Reference Books:

1) System of chemical control by N. 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. Prinsen Geenligs

B.Sc. Part II Semester - IV
Subject Title: Chemical Control (Boiling House Control) DSCST28

UNIT – 1 **[15]**

1.1 – Definition & Formulae:

- Technical definition
- Basic formulas for daily manufacturing report.

1.2 - Calculation for run report

- Pol, Brix, Non-sugar balance
- Clarification efficiency & clarification factor
- Stock taking & available sugar.
- Boiling house losses.
- Equivalent standard granulated. (ESG)

1.3 - Conversion of raw sugar recovery into white sugar recovery by using ESG formula

- Virtual final molasses purity.
- Operation including &excluding stoppage.

UNIT– 2 **[15]**

2.1- Boiling House Recovery:

- 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

2.2 - Control parameters and norms for efficiency.

Reference Books:

1) System of chemical control by N. 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. Prinsen Geenligs

B.Sc. II (Sugar Technology)
Subject Tittle: Sugar Manufacturing - I (Practical) DSCSTP5

1) To determine the Brix of the given sample by Bx Hydrometer & Hand refractometer
2) To find out the Purity of given sample of Juice.
3) To determine the Purity of Syrup and Molasses
4) To determine the purity of the Massecuite
5) To determine the Pol % and Moist % of the Bagasse
6) To determine the Pol % and Moist % of the Fillter cake
7) To determine the pH of the given sample by
    a. Test Paper
    b. Helige comparator
    c. pH meter
8) To determine the phosphate contents in the given sample by Spectrophotometer
9) To determine the Reducing sugar by Eyon & lane Method

B.Sc. II (Sugar Technology) (DSCSTP6)
Subject Tittle: Sugar Manufacturing – II (Practical)

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 P_2O_5 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 contain of massecuite by nutsh apparatus/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.

B.Sc. II (Sugar Technology)
Subject Tittle: Sugar Engineering (Project) DSCSTP7

Related to sugar industries - 100 marks (project - 75 mark + oral – 25 marks)
Project Consist of existing machinery and equipment's used for various mechanical and Purification process of sugar industries:

1) Name of machinery/equipment
2) Objects
3) Specification
4) Operation/working
5) Maintains
6) Remark - alternation/modification required.

B.Sc. II (Sugar Technology)
Subject Tittle: Environmental Studies (Project) (DSCSTP8)

Nature of Question Paper for Theory and Practicals:

	Theory paper	**Total -80 marks**
1	a) Q.1 Answer in one sentence types of question. b) Q2. Long answer Type c) Q3. Short answer Type	8 marks 16 marks 16 marks
2	Internal exam – Group activity (SemIII) Case Study/ Oral (Sem-IV)	20 marks 20 marks
3	Practical Examination will be Annual	300 marks
4	**DSCSTP5** Major Practical Minor practical Spotting Viva Journal **DSCSTP6** Major Practical Minor practical Journal Spotting Viva	 40 Marks 20 marks 20 marks 10 marks 10 marks 40 Marks 20 marks 10 marks 20 marks 10 marks
5	**DSCSTP7** Project Report Presentation and viva	 75 Marks 25 Marks 75 Marks 25 Marks
6	**DSCSTP8** Environment Project	 30 Marks