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**SHIVAJI UNIVERSITY, KOLHAPUR - 416004,  
MAHARASHTRA**

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**शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४, महाराष्ट्र**

दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१-२६०९०९४  
०२३१-२६०९४८७



**SU/BOS/Science/347**

**Date: 24/06/2024.**

**To,**

The Principal,  
All Concerned Affiliated Colleges/Institutions  
Shivaji University, Kolhapur

**Subject:** Regarding Minor Change syllabi of M.Sc. Part-II (Sem.III & IV ) as per NEP-2020 (2.0) degree programme under the Faculty of Science and Technology.

**Ref:** SU/BOS/Science/09/ Date: 02/01/2024 Letter.

**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 Minor Change in syllabi, nature of question paper and equivalence of M.Sc. Part-II (Sem. III & IV ) as per NEP-2020 (2.0) degree programme under the Faculty of Science and Technology.

<b>M.Sc.Part-II (Sem. III &amp; IV) as per NEP-2020 (2.0)</b>			
1.	Alcohol Technology (Entire)	2.	Sugar Technology (Entire)

This syllabus, nature of question shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website [www.unishivaji.ac.in](http://www.unishivaji.ac.in), NEP-2020@suk(Online Syllabus).

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. 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	4	P.G Admission / Eligibility Section
2	The Chairman, Respective Board of Studies	5	Computer Centre/ Eligibility Section
3	B.Sc. Exam/ Appointment Section	6	Affiliation Section (U.G.) (P.G.)

**SHIVAJIUNIVERSITY, KOLHAPUR**



**Syllabus**

**for**

**M.Sc. Part - II**

**Sugar Technology (Entire)**

**(Under Faculty of Science & Technology)**

**AS PER NEP – 2020**

**(To be implemented from Academic Year 2024 - 25)**

**M. Sc. Programme Structure of Sugar Technology**

**NEP-2020 with Multiple Entry and Multiple Exit Option**

**M. Sc. Part II (Semester III & IV) (Academic Year-2024-25)**

Year (2 Yrs. PG)	Level	Semester	Major		Research Methodology (RM) (04 Credits)	OJT/FP (04 Credits)	Research Project	Cumulative Credits	Degree
			Mandatory Degree (20 Credits)	Elective					
I	6.5	Sem III	MMST 301: (4 Credits) MMST 302: (4 Credits) MMST 303: (4 Credits) PR-MMST 305: (2 Credits)	E-MST 304: (4Credits)	----		RP-MMST 306: (4 Credits)	22	PG Degree After Three Year UG OR PG Degree After Four Year UG Note: Note: All the Practical's/P roject will be discipline specific i.e. MMST oriented.
		Sem IV	MMST 401: (4 Credits) MMST 402: (4 Credits) MMST 403: (4 Credits)	E-MST 404: (4 Credits)	---		RP- In plant Training 405: (6 Credits)	22	
Cumulative Credits for PG Degree			26	08	---		10	44	
Total Cumulative Credits for 2 Year PG Degree			54	16	04		14	88	

Abbreviations:

**PG:** Post Graduation, **Yrs.:** Years, **Sem.:** Semester, **PR-MMST:** Practical Major

**Mandatory Sugar Tech,** **MEST:** Major Elective Sugar Tech, **RM:** Research

**Methodology,** **ITR:** Inplant Training Report, **RP:** Research Project.

## M. Sc. Programme Structure (NEP-2020) of Sugar Technology

### M. Sc. Part II (With effect from June 2024)

Semester III (Duration – Six Month)										
Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
		Theory & Practical			University Assessment (UA)			Internal Assessment (IA) & Practical		
		Lecture (Per week)	Hours (Per week)	Credits	Maximum Marks	Minimum Marks	Exam Hours	Maximum Marks	Minimum Marks	Exam Hours
1	MMST 301: Equipments Design & Drawing	4	4	4	80	32	3	20	8	1
2	MMST 302: Equipments Capacity Calculation	4	4	4	80	32	3	20	8	1
3	MMST 303: Chemical Control	4	4	4	80	32	3	20	8	1
4	E-MST 304: Alcohol Technology/ Biochemical Engineering	4	4	4	80	32	3	20	8	1
5	PR-MMST 305: Sugar Technology V	4	4	2	50	20	6	---	---	---
6	FPMMST 306: Research Project	--	--	4	--	--	--	100	40	---
<b>TOTAL</b>		---	---	<b>22</b>	<b>370</b>	---	---	<b>180</b>	---	---

<b>Semester IV (Duration – Six Month)</b>										
<b>Sr. No.</b>	<b>Course Code</b>	<b>Teaching Scheme</b>			<b>Examination Scheme</b>					
		<b>Theory &amp; Practical</b>			<b>University Assessment (UA)</b>			<b>Internal Assessment (IA) &amp; Practical</b>		
		Lecture (Per week)	Hours (Per week)	Credits	Maximum Marks	Minimum Marks	Exam Hours	Maximum Marks	Minimum Marks	Exam Hours
1	MMST 401: Allied Sugar Manufacturing	4	4	4	80	32	3	20	8	1
2	MMST 402: Allied Co product Manufacturing	4	4	4	80	32	3	20	8	1
3	MMST 403: Electronics & Instrumentation Engineering	4	4	4	80	32	3	20	8	1
4	E-MMST 404: Advance Sugar Technology & Engineering / OR Water Management & Zero discharge	---	8	4	80	40	3	20	---	---
5	MESTP 405: OJT-RP( In plant Training )	---	12	6	150	60	--	---	---	---
	<b>TOTAL</b>	---	---	<b>22</b>	<b>470</b>	---	---	<b>80</b>	---	---

## M.Sc. PART- II (Sugar Technology) (Semester -III)

**Title of Course: Equipments Design and Drawing (MMST 301)**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand design of juice heaters, sulphitor, evaporators.
2. Learn drawing of equipment for process chemical.
3. Acquire knowledge of designs of crystallizers & pan.
4. Acquire skill of drawing of centrifugal machine.

Get knowledge about Vacuum pan Pan capacity

Unit	Syllabus	Lectures
I	<p>a) 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.</p> <p>b) Juice Sulphitor - Factors used to design continuous juice sulphitor or reaction tank, Lime proportioning device (lime dosing), SO<sub>2</sub> gas distribution (So<sub>2</sub>gasdosing), Mechanical stirrer for mixing of reagent, Design of tank with respect of diameter, Automation for pH control, Construction of continuous juice sulphitor</p>	15
II	<p>a) Sulphur Burners/Furnace – Combustion process of sulphur, Quantity of air required, Capacity of sulphur burner, Construction of sulphur burner</p> <p>b) Juice Clarifier - Type of clarifier, Functional theory of operation, RetentionTime, Flash Tank, Capacity of Clarifier, Construction of clarifier</p>	15
III	<p>a) Evaporator - Heat transfer &amp; Evaporation coefficient, Heating Surface, Tube size andnoof tubes, Juice/syrup inlet-out letconnection, Sizing Triple/Quadruple/Quintuple, Steam requirement</p> <p>b) 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</p>	15
IV	<p>a) 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</p>	15

	<p>heating surface, Construction of pan,</p> <p>b) Crystallizers - Horizontal v/s Vertical crystallizers, Capacity of crystallizer, Various zones and their retention time in cooling process, Quantity of water required for cooling</p> <p>c) Centrifugals – Gravity factor, Type of screen, Massecurite curing cycle, DC/AC drive, variable frequency drive, Capacity of basket</p> <p>d) Hopper &amp; Grader - Drying &amp; cooling of sugar, Grading of sugar</p>	
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**Reference Book:**

- 1] Hand book of cane sugar E.Hugot
- 2] Cane sugar engineering -Peter Rain.
- 3] Machinery & equipments of sugar factory L.A.Tromp
- 4] Cane sugar hand book- R.B.L.Mathur
- 5] Modern milling of sugar cane Maxwell
- 6] Standard fabrication practices of cane sugar mill Delden.
- 7] The energy cane alternative, Alexander
- 8] Cane sugar manufacturing in India D. P. Kukkarni

# M.Sc. Part-II Sugar Technology (Semester-III)

## Title of Course: Equipment's Capacity Calculation (MMST 302)

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand Capacity of weighing scale and reaction tank.
2. Learn Capacity of equipment for process chemical.
3. Acquire knowledge of Capacity of juice heater.
4. Acquire skill of Capacity of evaporator.
5. Get knowledge about Vacuum pan Pan capacity.

### Unit – I

[15]

#### a) 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 SO<sub>2</sub> gas distribution system

#### b) Capacity of equipment for process chemical:

- Capacity of phosphoric acid tank and dosing equipment
- Capacity of lime preparation equipment's and lime pumps
- Capacity of sulphur burner and air compressor

### Unit – II

[15]

#### a) Capacity of juice heater:

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

#### b) Capacity of clarifier & vacuum filter

- 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



### Unit– III

[15]

#### a) Capacity of evaporator:

- Co-efficient of heat transmission
- Quantity of water evaporated
- 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

#### b) Vacuum 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
- Sizing of condenser, water requirement for condenser, capacity of injection pump

### Unit – IV

[15]

#### a) 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.

#### b) 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

### ReferenceBooks:

- 1) Hand Book of Cane Sugar, E. Hugot
- 2) Cane Sugar Engineering, Peter Rain.
- 3) Machinery & Equipments of Sugar Factory, L. A. Tromp
- 4) Cane Sugar Hand Book, R. B. L. Mathur
- 5) Modern Milling of Sugar Cane, Maxwell
- 6) Standard Fabrication Practices of Cane Sugar Mill, Delden.
- 7) Cane Sugar Manufacturing In India, D. P. Kulkarni

## M.Sc. Part – II (Sugar Technology) (Semester-III)

### Title of Course: Chemical Control (MMST 303)

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand Technical definition mill and boiling house Fundamental formula mill and boiling house.
2. Acquire knowledge of Calculation for mill house.
3. Acquire knowledge of Calculation for run report Pol, Brix, Non – sugar balance, Clarification efficiency & clarification factor, Stock taking & 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.
4. Acquire skill of Calculation for boiling house.
5. Get knowledge about control parameters.

Unit	Syllabus	Lectures
I	Technical definition mill and boiling house Fundamental formula mill and boiling house	15
II	Calculation for mill house Differential method for calculation of Brix % Bagasse, fibre % Bagasse, added water % fibre 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. Primary Extraction, Secondary Extraction, Mill Extraction, reduced mill extraction and whole mill extraction	15
III	Calculation for run report Pol, Brix, Non – sugar balance, Clarification efficiency & clarification factor, Stock taking & 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.	15
IV	Calculation for boiling house Recorded boiling house recovery, Theoretical boiling house recovery, Ideal boiling house recovery, Boiling house recovery (ESG), Reduced boiling house recovery (GUNDURAO), Overall recovery, Reduced	15

	overall recovery, Control parameters and norms for efficiency.	
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### **Reference books**

- 1) System of chemical control for cane sugar factories in India – N.C.Verma.
- 2) Method of chemical control in cane sugar factories. —H.C.Pprisen Geerligs.
- 3) International Commission for uniform method of sugar analysis–  
ICUMSA Publication

**ELECTIVE SUBJECTS**  
**M. Sc.PART-II (Sugar Technology) Semester -III**  
**Title of Course: Alcohol Technology (E-MMST 304)**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand the cane molasses, composition, gradation, storage of molasses.
2. Learn definition of molasses, total reducing sugar, fermentable sugar.
3. Acquire knowledge of Definition of yeast, Taxonomy of yeast.
4. Acquire skill of distillation process.
5. Get knowledge about Effluent treatment system in Distillery.

**Unit – I**

[15]

**a) Cane molasses:**

- Composition of molasses, gradation of molasses, storage of molasses, factors responsible for reducing the ratio (F/NF) of molasses, other use of molasses.

**b) Definition:**

- Molasses, Total reducing sugar, Fermentable/Unfermentable sugar, Residual sugar.
- Wort, Brix, Specific gravity, Distillation, Industrial alcohol, Proof spirit, Strength of spirit, Reflux, Vaporization.
- Saccharification, Scaling, Scrubber, Starch -sucrose, Rectification, Gelatinization, liquefaction, Reboiler

**Unit - II**

[15]

**a) Applied microbiology.**

- Definition of yeast, Taxonomy of yeast
- Morphology of yeast, type of microorganism.
- Common strain of yeast used for alcoholic fermentation.
- Growth requirement of yeast.
- Yeast structure & function of cellular components.
- Metabolic pathway of yeast
- Alcoholic pathway Glycolysis of EMP pathway

**b) Definition & type of fermenter**

- Traditional batch, fed batch & continuous fermentation
- Difference between batch & continuous fermentation.
- Alcohol production from sweet sorghum
- Alcohol production from cane syrup

**c) Propagation of pure yeast culture.**

- Isolation of yeast, preservation of yeast cell.
- Preservation of pure culture on agar salt.
- Preparation of slant, purpose of propagation.
- Fundamental of yeast growth (Aerobic & Anaerobic)
- Crab tree effect.
- Growth kinetics, significance of growth curve, lag phase, log phase, stationary

phase, death phase etc.

- Propagation stages & aspartic condition

### **Unit – III**

[15]

#### **a) Types of distillation process.**

- Atmospheric distillation
- MPR distillation
- MPR benefits of vacuum distillation, RS, ENA production.
- Production of anhydrous alcohol.
- Dehydration with molecular sieve process & membrane process.

#### **b) Distillation equipment's**

- Columns, its design & construction, its maintenance.
- Types of trays
- Types of condenser.
- Types of reboiles

### **Unit – IV**

[15]

#### **a) Effluent treatment system in Distillery,**

- Quality of effluent, IS specification of effluent.
- Biological treatments.
- Aerobic treatments,
- Anaerobic treatments

#### **b) Manufacturing of Methane Gas % Composting**

- Raw material requirement of biogas plant.
- Design & capacity of biogas plant
- Moisture free methane generation.
- Types of composting & their production
- Factors affecting composting process.
- Economics consideration in composting process.

### **Reference books:**

- 1) Hand book of alcohol technology, S. V. Patil
- 2) Industrial alcohol technology hand book, NPCS Board of consultant & engineer

**Elective**  
**M. Sc. PART-II (Sugar Technology) Semester - III**  
**Title of Course: Biochemical Engineering (E-MMST 304)**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand the Bioprocess engineering and technology.
2. Learn definition Structure of cells: Prokaryotes & Eukaryotes. Classification of microorganism. Taxonomy, control of microorganism – physical & chemical methods.
3. Acquire knowledge of Detailed structure of protein and enzymes.
4. Acquire skill of Fermentation Technology
5. Get knowledge about Downstream processing.

**Unit - I**

[15]

**a) Introduction:**

- Bioprocess engineering and technology. An introduction to basic biological science

**b) Microbiology:**

- Structure of cells: Prokaryotes & Eukaryotes. Classification of microorganism. Taxonomy, control of microorganism– physical & chemical methods.
- Biological functions of lipids, sugars, polysaccharides, amino acids, vitamins, biopolymers, Nucleic acids: RNA, DNA and their derivatives.

**Unit - II**

[15]

**a) Enzymes and proteins:**

- Detailed structure of protein and enzymes. Functions. Methods of production and purification of enzymes. Nomenclature and classification of enzymes. Kinetics & mechanism of enzymes action.

**b) Kinetics of enzyme action:**

- reversible enzyme, two substrate, multi-complexes enzyme kinetics. Experimental determination of rate parameters: Batch & continuous flow experiments, Batch Kinetics.

**c) Enzymes Inhibition:**

- effect of inhibitors, temperature & pH on the rates enzyme catalyzed reactions. Determination of kinetic parameters for various types of inhibitions. Dixon method. Enzyme immobilization: Uses, methods of immobilization.

**Unit - III**

[15]

**a) Fermentation Technology**

- Ideal reactors: A review of batch and continuous flow reactors for bio kinetic measurements. Microbiological reactors: operation & maintenance of typical aseptic aerobic fermentation processes.
- Formulation of medium source and nutrients. Introduction to sterilization of bioprocess equipment.

**b) Growth kinetics of microorganism:**

- Transient growth kinetics (different phase of batch cultivation). Quantification of growth kinetic, continuous culture, optimum dilution rate and washout condition in ideal chemostat. Introduction to fed batch reactors.

## **Unit - IV**

[15]

### **Downstream processing:**

- Strategies and steps involved in product purification.
- Methods of cell disruption, filtration, centrifugation sedimentation
- Types of chromatography technique
- Freeze drying /lyophilization & membrane separation processes.

### **Reference Book**

1. "Biochemical Engineering" by S Aiba
2. "Biochemical Engineering Fundamentals" by J E Bailey
3. "Biochemical Reactors" by B Atkinson
4. "Biochemical Engineering Fundamentals" by James E Bailey
5. ".BIOCHEMICAL ENGINEERING" by Sathyanarayana N Gummadi

## **Syllabus of Practical Courses - M. Sc. II Sugar Technology Semester-III**

### **Title of Course: Sugar Technology-V (PR-MMSTP 305)**

- 1) The Determination of sugar solution colour at pH 7.0 by the MOPS Method – Official Method GS 9/1/2/3 – 8 (2005), ICUMSA Method Book.
- 2) The determination of white sugar solution colour at pH 7.0 method GS 2/3 – 9 (2002) – ICUMSA Method Book.
- 3) The determination of white sugar solution colour - Official Method GS 2/3 – 10(2002), ICUMSA Method Book.
- 4) The determination of white sugar solution colour - Official, Method GS
- 5) 2/3 – 10 (2003), ICUMSA Method Book.
- 6) The determination of Conductivity ash in sugar, method GS 2/3 – 17(2002) – ICUMSA Method Book.
- 7) The determination of moisture in sugar method GS 2/1/3–15(2002) – ICUMSA Method Book.
- 8) The determination of reducing sugar in sugar method GS 2/3/9 – 5(2007) ICUMSA Method Book.
- 9) The Determination of Insoluble Matter in White Sugar by Membrane Filtration Method GS 2/3/9 – 19 (2007) ICUMSA Method Book.
- 10) Mesophilic Bacteria in Sugar ICUMSA method GS2/3-41 (1998)
- 11) Yeasts and Moulds in Sugar ICUMSA method GS2/3-47 (1998)
- 12) Analysis of sulphur
  - a. Moisture % sulphur
  - b. Ash % sulphur
  - c. Purity of sulphur
- 13) Determination of Cao & grit % in given sample of lime by sucrose method.
- 14) Determination of density & phosphate content in phosphoric acid.
- 15) Determination of SO<sub>2</sub> in hydrogen peroxide.
- 16) Mill sanitation –
  - a. Dithio-Carbamate base
  - b. Quaternary ammonium compound.



**M. Sc. II Sugar Technology Semester-III**  
**Research Project Paper Guidelines for all specializations**

**Credits= 04, 120 Hours, 100 Marks**

**Title of Course: RP( Field Project)(RP-MMST 306)**

- The students should write synopsis of proposed research work.
- The students should perform detail literature survey related to research problem.
- The students should write review article related to research problem.
- It is expected to publish the review article either in Shivaji University Journal or peer reviewed journals.
- The students should design the problem and start experimental work. The students should complete at least 25% of their experimental work during the semester III and the same work to be continued in semester IV.
- The student should submit the spiral bound copy of research work carried out during semester III including the synopsis, research proposal, review article and certified progress report.
- The Research Project will be examined jointly by internal and external examiners during the practical examination at the end of the semester.
- The students should present their work during the evaluation in the form of power point presentation (PPT) .
- Marking Scheme:

Sr.	Description	Marks
1	Synopsis	10
2	Research Proposal	20
3	Review article on proposed work	20
4	Daily Lab notebook record	10
5	Progress of Experimental work	20
6	Quality and effectiveness of presentation	20
	<b>Total</b>	<b>100</b>

### **Broad guidelines for preparation of synopsis**

- A. The proposed synopsis for research should be self contained and should cover the rationale for carrying out research.
- B. There should not be repetition of the work or topic or theme.
- C. The synopsis of the proposed research shall contain the following points :
  1. Title of the Research Proposal
  2. Motivation with reasoning and significance of the proposed research
  3. Statement of the problem
  4. Review of the relevant literature
  5. Objectives of the study
  6. The methodology comprising
    - a. Methods of research
    - b. Sampling design and assumptions
    - c. Conceptual framework if any
    - d. Research design (explanation of how research is being conducted and the tools used for the same)
    - e. Methods of data collection
    - f. Methods of data analysis (use of parametric and non-parametric tools and techniques as the case may be)
  7. Expected outcome
  8. Bibliography.

### **Template for Research Proposal**

- Title
- Introduction
- Origin of the research problem
- Interdisciplinary relevance
- Review of Research and Development in the Subject
- Significance of the study
- Objectives
- Plan of research work

Students need to visit at least 2 sugar factory and take two any issues in ongoing season from sugar industry and make project report on the same problem with their solution. Students should complete above task.

## M.Sc. Part-II Sugar Technology (Semester-IV)

**Title of Course: Allied Sugar Manufacturing (MMST 401)**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand the Manufacturing of Raw Sugar.
2. Learn definition of Manufacturing of Jaggery & Jaggery Powder.
3. Acquire knowledge of Manufacturing of Refine Sugar.
4. Acquire skill of Manufacturing of Khandsari sugar.

**Unit – I** [15]

### **Manufacturing of Raw Sugar:**

- Specification of Raw sugar
- Clarification process
- Crystallization process
- Centrifugal process

**Unit – II** [15]

### **Manufacturing of Jaggery & Jaggery Powder:**

- Extraction & clarification of juice
- Concentration of juice to rab
- Drying & packing of Jaggery
- Crystallization process of Jaggery powder
- Curing, Drying and packing of Jaggery powder

**Unit – III** [15]

### **Manufacturing of Refine Sugar**

- Specification of refine sugar
- Types of refineries
- Mingling and affination process
- Clarification of refine melt
- Evaporation & crystallization
- Curing, Drying and packing of refine sugar

**Unit – IV** [15]

### **Manufacturing of Khandsari sugar**

- Specification of Khandsari sugar
- Extraction & clarification of cane juice
- Open pan boiling system
- Purging, drying & packing system

### **Reference Books:**

- 1) Hand Book of Sugar Refinery, Chung Chi Chou
- 2) Manufacture & Refining of Raw Sugar, V.E. Baikow

**M.Sc. Part II Sugar Technology (Semester -IV)**  
**Title of Course: Allied Co-Product Manufacturing (MMST 402)**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand the cane molasses, composition, gradation, storage of molasses.
2. Learn definition of Press Mud (Filter Cake).
3. Acquire knowledge of Definition of Bagasse, Composition of bagasse, Molasses for production of alcohol process, Taxonomy of yeast.
4. Acquire skill of Ethanol Production.
5. Get knowledge about Production of ethanol from cane juice and cane syrup.

**Unit- I** **[15]**

**Molasses:**

- Composition of molasses
- Storage of molasses
- Quality of molasses
- Pre-clarification of molasses
- Molasses for production of alcohol process
- Molasses for production of yeast process
- Molasses for production of acetone process
- Molasses for production of glycerin process
- Molasses for production of cattle feed process
- Other use of molasses in different countries

**Unit - II** **[15]**

**Press Mud (Filter Cake):**

- Composition of filter cake
- Use of filter cake as fertilizer process
- Use of filter cake for production of cane wax process
- Use of filter cake for production of bio-gas process
- Use of filter cake as fuel process
- Use of filter cake as cattle feed process

**Unit - III** **[15]**

**Bagasse:**

- Composition of bagasse
- storage of bagasse
- Separation of pith from bagasse
- Production of pulp and paper from bagasse process
- Production of particle board and fiber board from bagasse process
- Production of corrugated boards and boxes from bagasse process
- Production of furfural from bagasse process
- Production of xylitol from bagasse process
- Production of plastic from lignin in bagasse process
- Production of methane & product gas from bagasse process

- Production of cattle feed from bagasse process
- Other use of bagasse and bagasse ash
- Generation of surplus power from bagasse

#### **Unit- IV**

[15]

##### **Ethanol Production:**

- Production of ethanol from cane juice and cane syrup.
- Extraction of juice process.
- Clarification of juice process.
- Evaporation process.
- Fermentation process.
- Distillation process.
- Dehydration process.

##### **Reference Books:**

- 1) Ethanol & Distillation by H.C. Barron
- 2) The Book on Sugarcane Processing & By-Products of Molasses – H. Panda.
- 3) Process Synthesis for Fuel Ethanol Production - C.A. Cardona.
- 4) Kale U.M. (1990) Glance at Distillery By-Products DSTA 40<sup>th</sup> Convention.

## M. Sc.PART-II Semester -IV

### Title of Course: Electronics & Instrumentation Engineering (MMST403)

Total Credits: 04

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand the Basic Electronics, Number Systems, Boolean Algebra, Logic Gates.
2. Learn definition of Instrumentation.
3. Acquire knowledge of Pressure measurement.
4. Acquire skill of pH and conductivity measurement.
5. Get knowledge about Control System.

#### Unit - I

[15]

##### Basic Electronics:

- Circuit elements in series & parallel. Semiconductor Devices – Diode as Rectifier, Zener Diode as Voltage Regulator, Transistor as Amplifier. Field Effect Transistor –Jfet & Mosfet. Thyristor – Silicon Controlled Rectifier.

##### Number Systems:

- Decimal & binary systems, binary addition, subtraction, multiplication, division, use of complement

##### Boolean Algebra:

- Basic laws of Boolean algebra, De-Morgan's theorems, minimization techniques.

##### Logic Gates:

- OR, AND, NOT, NOR, NAND, EXOR gates.

##### Arithmetic Logic Units:

- Half adder, full adder, parallel binary adder and subtractor. Introduction to basic configuration of computer.

#### Unit -II

[15]

##### Instrumentation:

- Introduction, important terms associated with instruments such as range, span, accuracy, error and sensitivity.

##### Flow measurement:

- Types of flow, flow transducers - orifice plate, pitot tube, venturimeter. Description of rotameter, magnetic flow meter, ultrasonic flow meter etc.

##### Temperature measurement-

- Introduction to filled system thermometers, Expansion thermometers, thermocouples, RTD's, Thermostats and pyrometers.

#### Unit – III

[15]

##### Pressure measurement:

- Various units and their conversion, manometers, Bourdon tube, diaphragm, bellows, capsule, strain gauges for pressure measurement.

**Level measurement:**

- Direct methods - float methods, magnetic level indicator, magnetic level switches, indirect method - hydrostatic method, radiation method, ultrasonic method and capacitance method.

**pH and conductivity measurement:**

- Introduction, different types of sensors, pH meter and conductivity meter.

**Unit – IV**

**[15]**

**Control System:**

- Closed Loop System - Basic components. Servo and regulator control. Controllers – P, I, D and On –Off modes. Controller combinations - Final control elements - Valves, actuators and valve positioners.
- PLC system, DCS system, SCADA system

**Reference Book:**

- 1) Hand book of sugar engineering By-H.Eugot
- 2) Industrial automation –process control & instrumentation- By S.Medida
- 3) The complete book on sugar cane processing –chapter 24 By H-panda
- 4) Instrumentation & automation in sugar industries By-S.S.Engineering.
- 5) Instrumentation –Shivaji University By Anand M.S.
- 6) Industrial Instrumentation By H.K Singh

## **ELECTIVE SUBJECTS**

### **M.Sc. Part II (Sugar Technology) Semester -IV**

#### **Title of Course: Advance Sugar Technology & Engineering (E-MMST 404)**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand screening of the juice Effect of bagasillo on manufacturing process ,its removal by DSM screen, rotary screen & two stage rotary screens, Advantage of rotary Screen .Learn definition of Instrumentation.
2. Learn Juices tabilization & pH control system Online mass flow meter for juice weighment, Auto pH control system for juice clarification.
3. Acquire knowledge of Cane diffuser.
4. Acquire skill of Mill Efficiency.
5. Get knowledge about Co-generation of surplus power and its potential.

#### **Unit - I**

**[15]**

- Screening of the juice:  
Effect of bagasillo on manufacturing process, its removal by rotary screen & two stage rotary screens, Advantage of rotary Screen
- Juice stabilization & pH control system:  
juice flow stabilization system & Auto pH control system for juice clarification
- New trends in clarification:  
Filtrate and syrup clarification, Advantages of above both processes
- S.R.T:  
Tray less clarifier or short retention time (S.R.T.) Clarifier, construction and working
- Decanter:  
Muddy juice treatments, construction and working

#### **Unit - II**

**[15]**

- Sulphur Burner:  
Film type sulphur burner, Instrumentation and automation for film type sulphur burner.
- Steam Economy:  
Vapor bleeding and steam economy, Basic requirement of steam, Steam requirement when vapor are used for entire juice heating, Steam requirement when vapor are used for juice heating and pan boiling,
- Pan Automation:  
Pan boiling instrumentation and automation system for batch and continuous pan,



Automatic Brix and temperature measurement of molasses conditioner, Automatic Brix and temperature measurement of melter

- Centrifugal Control:  
Auto feed control system for centrifugal, Wash water system for centrifugal

### **Unit - III**

**[15]**

- Mill Efficiency:  
Various factors affecting milling capacity and efficiency
- Mill Control:  
Auto cane feeding control system for uniform feed rate, Automatic imbibitions water flow and temperature control system, Central lubricant system
- Pressure feeding system:  
TRPE, GRPF, UFR
- Two roller mill
- Cane Diffuser  
Heat and mass balance in cane diffuser, construction and working of the diffuser, comparison of cane diffuser with mill

### **Unit - IV**

**[15]**

- Co-generation of surplus power and its potential.
- Power saving device  
A.C.VFD drive  
Planetary gearbox
- Heat recovery unit  
Flash recovery system, condensate heat recovery system, H.P heater for High pressure boiler, vapcon system, sulphur burner
- Boiler water Treatment  
Boiler Feed Water Treatment Plant, chemical treatment 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 of Cane Sugar Factory- By Trom

## **ELECTIVE SUBJECT**

### **M.Sc. -Sugar Technology Part II Semester - IV**

#### **Title of Course: Water Management & Zero Discharge (E-MMST 404)**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand screening of the Water & water treatments.
2. Learn Boiler water treatments.
3. Acquire knowledge of Cooling tower & cooling water treatments.
4. Acquire skill of Automation and instrumentation for safety working.
5. Get knowledge about Air pollution; source & control equipments

#### **Unit – I**

**[15]**

##### **Water & water treatments:**

- Water properties & nature, Source of water, Uses of water & basic chemistry, Water related table
- Treatments- Filtration, Clarification, Oxidation, Chlorination, De-aeration
- Ion-exchange method, Softener De-alkalization, Demineralization application & limitation. Resin
- Membrane technology Ultra filtration, Nano filtration, Reverse osmosis, Electro-dialysis

#### **Unit – II**

**[15]**

##### **Boiler water treatments**

- Feed water treatment, Condensate treatment, Boiler water treatment.
- Boiler blow down, Reasons of boiler failures, Boiler preventive maintenance. Tubes internal chemical cleaning
- Boiler feed & boiler water treatments, boiler water limits. Carryover & priming in boiler.

#### **Unit – III**

**[15]**

##### **Cooling tower & cooling water treatments**

- Cooling tower, Need of cooling tower, Classification of cooling tower. Cooling tower maintenance Cooling tower technical definition & calculations
- Treatment of cooling water (physical & chemical), Problem in cooling water treatments
- Analytical methods & lab equipments, Recommended analytical methods  
Recommended analytical equipments, Composition of reagents
- Expression & interpretation of analytical result  
Analysis of raw water, clarifier water, filter water, soft water, ultra filtration of water, R. O. water, D. M. Water & mixed bed water, Make up and recalculating life.

## **Unit – IV**

[15]

### **Automation and instrumentation for safety working at**

- Water treatment
- Effluent treatment
- In plant control method
- Environment acts and guide line.
- Air pollution; source & control equipments

### **Reference Books:**

- 1) Efficient management in sugar industries, Mangal Singh
- 2) Geo economical study of waste water management of sugar industries, S. A. Manglekar
- 3) Ge betz hand book
- 4) Nalco water treatments Albtros hand book

## M. Sc. PART-II (Sugar Technology) (SEMESTAR-IV)

### (MMSTRP405) In plant Training Report

Credits= 06, 180 Hours, 150 Marks

- The student should submit the final bound dissertation/thesis copy of research work carried out during semester III and IV.
- It should include title page, certificate, declaration, acknowledgement, abbreviations, index, abstract, introduction, experimental section, results and discussion, conclusions, references, participation in conferences/seminars and publications if any.
- The students should present their work during the evaluation in the form of power point presentation (PPT) .
- **Marking Scheme:**

Sr. No.	Description	Marks
1	Dissertation/thesis bound copy	30
2	Quality of work ( Innovative concepts, social relevance, extent of work etc.)	50
3	Publications	20
4	Participation in conferences	10 maximum
	a) Oral/Poster Presentation (10 marks)	
	b) Only attended (7 marks)	
5	Final Dissertation/thesis defense	40
	<b>Total</b>	<b>150</b>

**Note:** The Project will be examined jointly by internal (Project Supervisor) and external examiners (preferably Associate professor and above with Ph. D.) at the end of the semester. The project can be given individually or a maximum group of three students is allowed. (Not more than three students allowed).

**In this course short thesis regarding scheme of project & Actual practical work. The report contents following points**

- A) Factory Practice (Internship/In-Plant Training)
- B) Cane Department
- C) Milling
- D) Boiler
- E) Power House & Electrical Dept.
- F) Clarification Section
- G) Sulphiter
- H) Clarifier
- I) Filtration
- J) Evaporation
- K) Pan Floor
- L) Crystallizer & Centrifugals
- M) Centrifugals
- N) Sugar Dryer
- O) Effluent Treatment

## Nature of Question Paper for Theory and Practical

	<b>Theorypaper</b>	<b>marks</b>
1	<p>Q.1 Answer in one sentence types of question.</p> <p><b>Attempt any two from section I.</b></p> <p><b>Section I:</b></p> <p>Q2: Long questions on Unit I</p> <p>Q3: Long questions on Unit II</p> <p>Q4: a) Short answer questions on Unit I b) Short answer questions on Unit II</p> <p><b>Attempt any two from section II.</b></p> <p><b>section II:</b></p> <p>Q5: Long questions on Unit III</p> <p>Q6: Long questions on Unit IV</p> <p>Q7: a) Short answer questions on Unit III b) Short answer questions on Unit IV</p>	<p style="text-align: center;">16 marks</p> <p>Each Question 16 marks</p> <p>Each Question 16 marks</p>
2	Internal exam - It consists of 20 questions for 1 mark each.	20 marks
3	<b>Practical Examination</b> will be Semester wise (Sem III-150 + Sem IV - 150)	300 marks
4	<p style="text-align: center;"><b>PR-MMST 305</b></p> <p style="text-align: center;">Major Practical Minor practical Journal Viva</p> <p style="text-align: center;"><b>FP-MMST 306</b></p> <p style="text-align: center;">Report Presentation Site visit Viva</p>	<p style="text-align: center;">25 Marks 15 marks 05 marks 05 marks</p> <p style="text-align: center;">50 marks 20 Marks 20 marks 10 marks</p>
5	<p><b>MMSTP 405:</b></p> <p>Inplant Report Presentation viva</p>	<p>100 Marks 25 Marks 25 Marks</p>