

# SHIVAJI UNIVERSITY KOLHAPUR



Estd.:1962

NAAC 'A' Grade,

MHRD-NIRF- 28<sup>th</sup> Rank

## Syllabus for

### Master of Science Sugar Technology

Part I (Semester I & Semester II & Practicals )

**Syllabus to be implemented from June 2020**

## M.Sc. Programme structure (CBCS pattern) (2020 - 21)

### M.Sc. Part I

<b>SEMESTER-I (Duration- Six Month)</b>											
	Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA) and Practical		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
<b>CGPA</b>	1	CC 101	4	4	4	80	32	3	20	8	1
	2	CC 102	4	4	4	80	32	3	20	8	1
	3	CC 103	4	4	4	80	32	3	20	8	1
	4	CC 104	4	4	4	80	32	3	20	8	1
	5	CCPR 105	16	16	8	--	--	--	200	80	*
<b>Total (A)</b>			--	--	<b>24</b>	<b>320</b>	--	--	<b>280</b>	--	--
<b>Non-CGPA</b>	1	AEC	2	2	2	--	--	--	20	8	1
<b>SEMESTER-II (Duration- Six Month)</b>											
<b>CGPA</b>	1	CC 201	4	4	4	80	32	3	20	8	1
	2	CC 202	4	4	4	80	32	3	20	8	1
	3	CC 203	4	4	4	80	32	3	20	8	1
	4	CC 204	4	4	4	80	32	3	20	8	1
	5	CC PR 205	16	16	8	--	--	--	200	80	*
<b>Total(B)</b>			--	--	<b>24</b>	<b>320</b>	--	--	<b>280</b>	--	--
<b>Non-CGPA</b>	1	SEC	2	2	2	--	--	--	20	8	1
<b>Total (A+B)</b>					<b>48</b>	<b>640</b>	--	--	<b>560</b>	--	--

<ul style="list-style-type: none"> <li>• Student contact hours per week : <b>32 Hours</b>(Min.)</li> </ul>	<ul style="list-style-type: none"> <li>• Total Marks for M.Sc.-I : <b>1200</b></li> </ul>
<ul style="list-style-type: none"> <li>• Theory and Practical Lectures : <b>60 Minutes</b> Each</li> </ul>	<ul style="list-style-type: none"> <li>• Total Credits for M.Sc.-I (Semester I &amp; II) : <b>48</b></li> </ul>
<ul style="list-style-type: none"> <li>• CC-Core Course</li> <li>• CCPR-Core Course Practical</li> <li>• AEC-Mandatory Non-CGPA compulsory Ability Enhancement Course</li> <li>• SEC-Mandatory Non-CGPA compulsory Skill Enhancement Course</li> </ul>	<ul style="list-style-type: none"> <li>• Practical Examination is annual.</li> <li>• Examination for CCPR- 105 shall be based on Semester I Practicals.</li> <li>• Examination for CCPR- 205 shall be based on Semester II Practicals.</li> <li>• *Duration of Practical Examination as per respective BOS guidelines</li> <li>• <b><i>Separate passing is mandatory for Theory, Internal and Practical Examination</i></b></li> </ul>

**M.Sc. Programme structure (CBCS PATTERN) (2020-21)**

**M.Sc. Part – II**

<b>SEMESTER-III (Duration- Six Month)</b>											
	Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
			Theory and Practical			University Assessment (UA)			Theory and Practical		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
<b>CGPA</b>	1	CC 301	4	4	4	80	32	3	20	8	1
	2	CC 302	4	4	4	80	32	3	20	8	1
	3	CC 303	4	4	4	80	32	3	20	8	1
	4	CC 304	4	4	4	80	32	3	20	8	1
	5	CCPR 305	16	16	8	--	--	--	200	80	*
<b>Total (C)</b>			--	--	<b>24</b>	<b>320</b>	--	--	<b>280</b>	--	--
<b>Non-CGPA</b>	1	AEC	2	2	2	--	--	--	20	8	1
	2	EC (SWM MOOC)	Number of lectures and credit shall be as specified on SWAYAM MOOC								
<b>SEMESTER-IV (Duration- Six Month)</b>											
<b>CGPA</b>	1	CC 401	4	4	4	80	32	3	20	8	1
	2	CC 402	4	4	4	80	32	3	20	8	1
	3	CC 403	4	4	4	80	32	3	20	8	1
	4	CC 404	4	4	4	80	32	3	20	8	1
	5	CC PR 405	16	16	8	--	--	--	200	80	*
<b>Total (D)</b>			--	--	<b>24</b>	<b>320</b>	--	--	<b>280</b>	--	--
<b>Non-CGPA</b>	1	SEC	2	2	2	--	--	--	20	8	1
	2	GE	2	2	2	--	--	--	20	8	1
<b>Total (C+D)</b>					<b>48</b>	<b>640</b>	--	--	<b>560</b>	--	--

Student contact hours per week : <b>32 Hours (Min.)</b>	• Total Marks for M.Sc.-II : <b>1200</b>
• Theory and Practical Lectures : <b>60 Minutes Each</b>	• Total Credits for M.Sc.-II (Semester III & IV) : <b>48</b>
<ul style="list-style-type: none"> <li>• CC-Core Course</li> <li>• CCS-Core Course Specialization</li> <li>• CCPR-Core Course Practical</li> <li>• AEC-Mandatory Non-CGPA compulsory Ability Enhancement Course</li> <li>• SEC-Mandatory Non-CGPA compulsory Skill Enhancement Course</li> <li>• EC (SWM MOOC) - Non-CGPA Elective Course</li> <li>• GE- Generic Elective</li> </ul>	<ul style="list-style-type: none"> <li>• Practical Examination is annual.</li> <li>• Examination for CCPR- 305 shall be based on Semester III Practicals.</li> <li>• Examination for CCPR- 405 shall be based on Semester IV Practicals.</li> <li>• *Duration of Practical Examination as per respective BOS guidelines</li> <li>• <b><i>Separate passing is mandatory for Theory, Internal and Practical Examination</i></b></li> </ul>

**Total Credits for M.Sc. Program: 96**

**Total Marks for M.Sc. Program: 2400**

### **I. CGPA course:**

1. There shall be 14 Core Courses (CC) per program.
2. There shall be 02 Discipline Specific Elective (DSE) courses of 08 credits per program.
3. There shall be 04 Core Course Specialization (CCS) courses of 16 credits per program.
4. Total credits for CGPA courses shall be of 96 credits per program.

### **II. Mandatory Non-CGPA Courses:**

1. There shall be 02 Mandatory Non-CGPA compulsory Ability Enhancement Courses (AEC) of 02 credit each per program.
2. There shall be 01 Mandatory Non-CGPA compulsory Skill Enhancement Course (SEC) of 02 credits per program.
3. There shall be one Elective Course (EC) (SWAYAM/MOOC). The credits of this course shall be as specified on SWAYAM/MOOC portal.

4. There shall be one Generic Elective (GE) course of 02 credits per program. Each student has to take Generic Elective from the department other than parent department.
5. The total credits for Non-CGPA courses shall be of 08 credits + 2 to 4 credits, as specified on the SWAYAM/MOOC portal.
6. The credits assigned to the course and the program shall have no relation with the work-load of the teacher.

### M.Sc. Part I (Sugar Technology)

#### Sem - I

	<b>Course code</b>	<b>Paper No.</b>		<b>Title of course</b>	
CGPA	CC101	I	ST 1.1	Sugar cane Agriculture	All courses are compulsory
	CC102	II	ST 1.2	Sugar Processing – clarification & evaporation	
	CC103	III	ST 1.3	Sugar engineering – Milling	
	CC104	IV	ST1.4	Chemical Control	
	CCPR105		STP 1.1	Practical – I	
Non CGPA	AEC 106				

### M.Sc. Part I (Sugar Technology)

#### Sem - II

	<b>Course code</b>	<b>Paper No.</b>		<b>Title of course</b>	
CGPA	CC201	V	ST 2.1	Sugar Chemistry	All courses are compulsory
	CC202	VI	ST 2.2	Sugar Processing – Crystalization&finishing	
	CC203	VII	ST 2.3	Sugar Engineering – Steam &Power Generation	
	CC204	VIII	ST 2.4	Equipment Design &Drawing	
	CCPR205		STP 2.1	Practical – II	
Non CGPA	SEC 206				

### M.Sc. Part II (Sugar Technology)

#### Sem - III

	<b>Course code</b>	<b>Paper No.</b>		<b>Title of course</b>	
CGPA	CC301	IX	ST 3.1	Equipment's Capacity Calculation	All courses are compulsory
	CC302	X	ST 3.2	Allied Sugar Manufacturing	
	CC303	XI	ST 3.3	Chemical Engineering – Heat &Momentum	

				transfer	
	CC304	XII	ST 3.4 (A/B)	A)Bio-Chemical Engineering  B)Electronic and  Instrumentation Engineering	Choose any one
	CCPR305		STP 3.1	Practical – III	
Non CGPA	AEC 306				
	EC(SWMMOOC)- 307				

### M.Sc. Part II (Sugar Technology)

#### Sem - IV

	Course code	Paper No.		Title of course	
CGPA	CC401	XIII	ST 4.1	Allied Co-products Manufacturing	All courses are compulsory
	CC402	XIV	ST 4.2	Advanced Sugar Technology & Engineering	
	CC403	XV	ST 4.3	Chemical Engineering – Unit Operation	
	CC404	XVI	ST 4.4 (A/B)	A)Energyconversionandcogeneration B)WaterManagement & ZeroDischarge	Choose any one
	CCPR405		STP 4.1	Practical – IV	
Non CGPA	SEC 406				
	GE 407				

**Shivaji University, Kolhapur**

**Syllabus For**



## Master of Science ( Sugar technology)

### **1. Title : M.Sc. Sugar Technology**

M.Sc. Part I syllabus.

### **2 Year of implementation.**

Syllabus will be applicable from June 2020

### **3 Preamble/Introduction**

In India sugar cane becomes industrial crop and sugar industry becomes as integrated cane processing unit where in sugar, alcohol, energy and allied products are manufactured thus it is needed to provide technologists and scientists to the industry. At present there are two institutes which provide technical education related to the sugar industry. Namely National sugar institute Kanpur which is approved by Govt. of India. Dept. Of Food and Agriculture and Vasantdada Sugar Institute Pune which is approved by state Govt of Maharashtra and it is autonomous institute. Both the institutes are providing the education in the faculty of Sugar technology, Sugar engineering, Alcohol Technology, and Instrumentation Engg, in the capacity of Post Graduates Diploma. But in India there is no provision for the Bachelor and Master degrees in Sugar technology. & Alcohol Technology. Recently Maharashtra govt. permitted to start such a career oriented courses under science & Technology faculty, accordingly we are running B.Sc (Sugar Technology) courses since last Nine academic years. Due to growing demand from industries we wish to start M.Sc. (Sugar Technology).

### **4. General objects of the course.**

#### **Objectives :**

The objectives of the M.Sc. (Sugar Technology) Course shall be as follows:-

- 1) To develop the human resource in sugar technology sector which is the need of the hour?
- 2) To create the people who will teach the science of sugar technology, this will

It will also be helpful for the promotion of Research in this field.

- 3) To create several self-employment opportunities in sugar and allied industries sectors for modestly-trained and self-trained human resources existing in all geographic locations of the country.
- 4) It will help to develop the skills required in sugar technology and sugar management fields.
- 5) To develop proficiencies and skills for becoming successful scientist, technicians in ST sector.
- 6) To develop the expertise for the innovation of different skills and its implementation in ST Sector.
- 7) To explore the different techniques in ST sector

#### **5) Duration:-**

The duration of M.Sc. (Sugar technology) courses shall be of two years.

#### **6) Pattern for examination**

Semester pattern, theory paper and practical at end of each semester.

#### **7) Fee structure.-**

Decided by competent authority of university. / SSS

#### **8) Implementation of fee structure.:-**

In case of revision of fee structure, this revision will be implemented in phase wise manner

#### **9) Eligibility of admission**

B.Sc.(Sugar technology)

B.Sc.(Physics/Chemistry/Mathematics)

B.Tech.(Food/Chemical Technology)

B.E.Chemical Engineering

B.Sc. Food Technology

#### **10) Medium of instruction:**

The medium of instruction shall be in English

#### **11) Teachers Qualification:**

ANSI/AVSI (Sugar Tech,) ANSI/AVSI (Sugar Engg.)

M.Sc. (Sugar technology with NET/SET) or Ph.D

M.Sc. (Chemistry with NET/SET) Or Ph.D

M.Sc. (Botany with NET/SET) or Ph.D

BE/ME (Instrumentation)

BE/ME (Mechanical)

BE/ME (Chemical)

## 12 ) Structure of-course:

**M.Sc. (ST) First year**

**(Theory– 4 paper) Semester – 1**

### **Theory:**

<b>Sr.No</b>	<b>Theory– core-Subject</b>	<b>Code</b>	<b>Credits</b>	<b>Marks</b>
1	SugarCaneAgriculture	SCA	4	100
2	Sugarprocessing – Clarification& Evaporation	SPCE	4	100
3	SugarEngineering – Milling	SEM	4	100
4	ChemicalControl	CC	4	100
5	Total		16	400

### **Semester 1-Practical's**

<b>Srno</b>	<b>Practical Subject</b>	<b>Code</b>	<b>Credits</b>	<b>Marks</b>
1	SugarCane Agriculture	SCA	4	100
2	Sugar technology–I	ST – I	4	100
3	Total		8	200

### **Semester2- Theory**

<b>Sr. no</b>	<b>Theory – CoreSubject</b>	<b>Code</b>	<b>Credits</b>	<b>Marks</b>
1	SugarChemistry	SC	4	100
2	SugarProcessing – Crystallisation& Finishing	SPCF	4	100
3	Sugar Engineering – Steam&Power Generation	SESPG	4	100
4	Equipment DesignAndDrawing	EDD	4	100
5	Total		16	400

### **Semester2-Practical's**

<b>Sr.no</b>	<b>PracticalSubject</b>	<b>Code</b>	<b>Credits</b>	<b>Marks</b>
1	Sugarchemistry	SC	4	100
2	Sugar technology– II	ST-II	4	100
3	<b>Total</b>		<b>8</b>	<b>200</b>

### Semester– 3Theory

<b>S.N.</b>	<b>Theory– core/elective</b>	<b>Code</b>	<b>Credits</b>	<b>Marks</b>
1	EquipmentCapacity Calculation	ECC	4	100
2	Allied Sugar Manufacturing	ASM	4	100
3	Chemical Engineering-Heat And Momentum Transfer	CEHMT	4	100
4	Elective: A)Bio-Chemical Engineering B)Electronic And Instrumentation Engineering	ET: A)BCE B)EIE	4	100
5	Total		16	400

### Semester – 3Practical's

<b>Sr.No</b>	<b>Practical Subject</b>	<b>Code</b>	<b>Credits</b>	<b>Marks</b>
1	Sugar technology –III	ST-III	4	100
2	Practical onElectiveSubject	ET(P)	4	100
3	Total		8	200

### Semester4- Theory

<b>Sr.</b>	<b>Theory–core/elective</b>	<b>Code</b>	<b>Credits</b>	<b>Marks</b>
1	Allied Co-products Manufacturing	ACM	4	100
2	Advance Sugar Technology & Engineering	ASTE	4	100
3	ChemicalEngineering-Unit Operation	CEUP	4	100

4	Elective: A)Energyconversion andcogeneration B)Water management and zero discharge	ET: A)ECC B)WMZD	4	100
5	Total		16	400

### Semester-4 Practicals

Sr.No	Practical Subject	Code	Credis	Marks
1	Technical eassyon Elective Subject(SelfStudy)	TE	2	50
2	InplantTraining(Project Report)	IT	6	150
3	<b>Total</b>		<b>8</b>	<b>200</b>

### 13) Schemeofteaching and Examination

The schemeof teaching andexamination shouldbegivenasapplicable tothecourse / paper concerned.

#### A)Teaching:

Teaching consistsof lecturesfollowed by termworkandpractical's/Tutorials. There are 4papers of 100 marksatendofeachsemester. and 2 practical's/Tutorialof100markseachatendof eachsemester.

#### B) Examination:

Thesemesterexamination willbeconductedat theendof each termfortheoryand practical.

Theorypaperwill beof 80 markseachand20marksfor internalevaluation testconducted in themidoftheterm.

Practicalswillbe of 80 marks. and 20marksreserveforpresentation ofpractical log book .

Questionpaperswill beset in theviewoftheentiresyllabusand preferablycovering each unitofthe syllabus.

### 14) Standard of passing

As per rulesandregulationofM.Sc. course.

### 15) Nature of question paper and scheme of marking

Theoryquestionpaper (Maximummarks – 80)

Total No. of question – 7

All questions are of equal marks.

Out of these seven questions five questions are to be attempted.

Question No. 1 is compulsory and objective. Total no. of bits – 16, Total marks – 16 (which cover multiple choices, fill in the blanks, definition, true or false). These questions will be answered along with other questions in the same answer book.

Remaining 6 questions are divided into two sections, namely section – I and section – II. Four questions are to be attempted from these two sections such that not more than two questions from any of these sections are to be written in the same answer book.

### **16) Equivalence in accordance with title and content of paper (for revised syllabus)**

#### **M.Sc. Part – I Sem - I**

<b>S.R.</b>	<b>Old Subject</b>	<b>S.R.</b>	<b>New Subject</b>
1	Sugar Cane Agriculture	1	Sugar Cane Agriculture (ST1.1)
2	Sugar Processing – Clarification	2	Sugar Processing – Clarification & Evaporation (ST1.2)
3	Sugar Engineering – Milling	3	Sugar Engineering – Milling (ST1.3)
4	Chemical Control	4	Chemical Control (ST1.4)

#### **M.Sc. Part – I Sem- II**

<b>S.R.</b>	<b>Old Subject</b>	<b>S.R.</b>	<b>New Subject</b>
1	Sugar Chemistry	1	Sugar Chemistry (ST 2.1)
2	Sugar Processing – Evaporation	2	Sugar Processing – Crystallisation & Finishing (ST2.2)
3	Sugar Engineering – Steam & Power Generation	3	Sugar Engineering – Steam & Power Generation (ST2.3)
4	Equipment Design & Drawing	4	Equipment Design & Drawing (ST2.4)

#### **M.Sc. Part – II Sem- III**

<b>S.R.</b>	<b>Old Subject</b>	<b>S.R.</b>	<b>New Subject</b>
1	Equipment Capacity Calculation	1	Equipment Capacity Calculation (ST3.1)
2	Sugar Processing - Crystallisation	2	Allied Sugar

			Manufacturing(ST3.2)
3	Chemical Engineering – Heat & Momentum Transfer	3	Chemical Engineering – Heat & Momentum Transfer(ST3.3)
4	Elective: 1) Alcohol Technology 2) Bio-Chemical Engineering 3) Electronic And Instrumentation Engineering	4	Elective: A) Bio-Chemical Engineering B) Electronic And Instrumentation Engineering(ST3.4)

### **M.Sc. Part – II Sem – IV**

<b>S.R.</b>	<b>Old Subject</b>	<b>S.R.</b>	<b>New Subject</b>
1	Sugar Processing – Finishing	1	Allied Co-Products Manufacturing(St4.1)
2	Allied Sugar Manufacturing	2	Advanced Sugar Technology & Engineering (ST4.2)
3	Chemical Engineering – Unit Operation	3	Chemical Engineering – Unit Operation(ST4.3)
4	Elective: 1) Energy Conversion And Cogeneration 2) Pollution Prevention And Control 3) Water Management And Zero Discharge	4	Elective: A) Energy Conversion And Cogeneration B) Water Management And Zero Discharge(ST4.4)

### **17) Special instruction if any**

Not applicable at the first stage

Suggestions: After implementation

### **NOTE:**

- i) The details of field work, seminar, Group Discussion and Oral examination be given wherever necessary.
- ii) General/Specific instructions for Laboratory safety should be given wherever necessary

### **18) other feature**

Intake capacity: 50

### **19) Laboratory safety equipments:**

**Part: I Personal Precautions:**

- All persons must wear safety Goggles at all times.
- Must wear Lab Aprons/Lab Jacket and proper shoes.
- except in emergency, over – hurried activities is forbidden.
- Fume cupboard must be used whenever necessary.
- Eating, Drinking and Smoking in the laboratories strictly forbidden.

**Part: II: Use of Safety and Emergency Equipments:**

- First aid Kits
- Sand bucket
- Fire extinguishers (dry chemical and carbon dioxide extinguishers)
- Chemical Storage cabinet with proper ventilation
- Material Safety Data sheets.
- Management of Local exhaust system & fume hoods.
- Sign in register if using instruments.



## M.Sc. Sugar Technology Part-I (Semester-I)

### Paper: I (SCA)- Sugarcane Agriculture (ST 1.1)

Unit	
I	<p><b>Introduction:</b> Origin of Cane, cultivation in India, varieties, climatic conditions, sugarcane area</p> <p><b>Soil:</b> Types, properties – Visual &amp; morphological properties, analytical properties, fertility &amp; soil</p> <p><b>Planting:</b> Preparatory tillage, planting time, selection of seed cane, methods of planting – Flat, ridge</p> <p><b>Growth of Sugarcane:</b> Germination, development of shoot &amp; root – factors affecting, tillering, growth</p>
II	<p><b>Irrigation:</b> Water requirement, scheduling, method of irrigation – surface, overhead or sprinkler</p> <p><b>Manuring:</b> Cane nutrition, functions of macro &amp; micro (trace) nutrients, fertilizers – N, P, K, S, Zn, Cu, Mn, B, Mo, green manuring, time &amp; method of application, visual symptoms of nutrient deficiencies and disorders</p> <p><b>Weeds:</b> Common weeds, aquatic weeds, losses due to weeds, methods of weed control – mechanical, chemical</p> <p><b>Pests:</b> Leaf eating &amp; sucking insects, stalk attacking insects, root attacking insects, soil insects &amp; Non insect species</p> <p><b>Diseases:</b> Major diseases (red rot, smut, pineapple, mosaic, wilt etc), period of occurrence, control</p>
III	<p><b>Ripening:</b> Methods of judging ripeness or maturity, factors affecting ripening, accelerating ripening</p> <p><b>Harvesting:</b> Manual &amp; mechanical harvesting of cane, transportation of cane, post harvest detasseling</p> <p><b>Ratooning:</b> Definition, yield &amp; quality, number of ratoons, advantages and disadvantages, area requirement</p>
IV	<p><b>Breeding technique in sugarcane</b></p> <p>Ideal seed cane, seed cane treatment, measures to obtain higher germination, transplanting technique, sugarcane breeding, Breeding for yield, lodging resistance, resistance to frost, resistance to drought</p> <p>Sugarcane breeding institutes in India, Physiology of sugarcane under normal condition, Physiology of sugarcane under saline condition, Work on the physiology on various sugarcane</p>

### Reference Books:

- 1) Plant propagation – Hartman and Kester's
- 2) Principles and practices – Hudson T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. Robert L. Geneve.
- 3) Textbook of Plant Physiology – C. P. Malik.
- 4) Diseases of Crop Plants in India – G. Rangaswami and A. Mahadevan
- 5) Plant Pathology – R.S. Mehrotra
- 6) Practical cytology – Applied Genetics and Biostatistics – H.K. Goswami and Rajeev Goswami.
- 7) Recent Advances in Plant Diseases Vol – 1 to 5 – K. M. Chandaniwala.
- 8) Introduction to Principles of Plant Pathology – R. S. Singh.
- 9) An introduction to Plant Anatomy – Arthur R. Eames and Laurence H. Mac Deniels.
- 10) Genetics and Plant Breeding – E. B. Babcock.
- 11) Plant Taxonomy – O. P. Sharma.
- 12) Plant Breeding – Theory and Techniques – S. K. Gupta.

- 13) Breeding Asian Field Crops – John Milton Poehlman and Dhirendranath Borthakur.
- 14) Crop Production and Field Experimentation – Dr. V.G. Vaidya, K. R. Sahasrabudhe, Dr. V. S. Khuspe.
- 15) Agricultural Problems of India – A.N. Agrwal and Kundam Lal.

**M.Sc. I - Sugar technology (Semester - 1)**

**Paper – II Sugar Processing- Clarification & Evaporation (ST1.2)**

**Syllabus**

Sugar manufacturing process, Extraction of juice from cane, Maceration or imbibitions and their scheme Mills sanitation  
of DSM screen & Rotary screen, Weighing and metering of juice, Equipment detail and operation of Maxwell Boulogne  
Object of juice heating, Construction and working of vertical tubular juice heater  
Concept of vapor line and dynamic Juice Heater, Construction and working of DCH and PHE  
Precipitation. Preparation of milk of lime (MOL) and its equipment details. Separation of grit from MOL, Production  
operation of continuous & film type furnace, Role of phosphate in juice clarification and its use  
Decarification, Influence of lime on different constituents of juice, Effects of pH on sucrose and reducing sugar, Acti  
ecation, Sulphitation and carbonation, Comparison between sulphitation & carbonation,  
subsidiation, Speed of subsidiation Construction and operation of DORR multi feed clarifier,  
ifier, Its construction and operation, Preparation of settling chemical and its use, juice and mud removal  
l, Construction and working of vacuum filter, Washing of cake, Mini condenser or vacuum pump, Quality of filtra  
of decanter  
Quantity of water evaporated from juice, Heat transfer in evaporator, Boiling point of juice, Norbert Rolex principle applica  
erent types of evaporator body, Entrainment and entrainment separator Condenser and type of condenser, Quantity of  
aporator, Starting of evaporator, Juice level line evaporator, Condensate and non-condensable gas removal, Flash recov  
ement of steam, Steam economy when vapor used for juice heating, Steam economy when vapor used for juice heating a  
of syrupsulphitor, 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 Of Raw Sugar – Baikow
- 6) By Product Of Cane Sugar Industries –Paturau.
- 7) Cane SugarHand Book – R.B.L.Mathur
- 8) Cane SugarManufacturingInIndia–D.P.Kulkarni

**M.Sc-I Sugar Technology (Semster-I)**

**Paper:III-(SEM)Sugar Engineering--Milling (ST1.3)**

Unit	Syllbus	Lectures
I	<p><b>Cane weighbridges:</b>types,capacity etc.</p> <p><b>Cane handling and feeding Cane unloading-</b>Bridgewithtrrolley – having sling bar system – twomotion/three motion, auto de-hooking system</p> <p><b>Feeder table</b> – size, slope, chain,breakingstrength, power consumption,drive etc.</p> <p><b>Cane carrier</b> – horizontal&amp;inclinedcarrier,feeding length,Widthofcarrier, Speed of carrier,capacityof carrier, powerconsumptionofcarrier,Typesofcarrier 1) single cane carrier 2)Splitcane carrier.3)Rake cane carrier4)Belt carrier,Tramp iron</p>	15

	sepetor.	
II	<p><b>Cane preparations</b></p> <p>Preparation of cane, various devices of cane preparation like kicker, chopper, leveler, cutter fibrizer and shredder</p> <p>Measurement of preparation index by bulk density method, sieving method, leaching method.</p>	15
III	<p><b>Mills and mill components</b> – Conventional three roller mill.</p> <p>Mill Headstocks, Mill rollers &amp; rollers grooving</p> <p>Grooving types – V-grooves, Messchaert grooves &amp; chevron grooves</p> <p>lotus roller, Mill hydraulics system, Mill bearings &amp; their types</p> <p>Mill roller pinions, Trash &amp; Scrapper plates</p>	15
IV	<p>Mill drive types with merit and demerit, Mill power requirement, Mill gearing, Mill couplings and tail bars</p> <p><b>Mill setting</b> – Rollers setting, pressure feeders setting, under feed rollers setting, donelley chute opening, trash plate setting, practical optimization of mill setting</p> <p>Checking of mill performance by Brix curve</p> <p><b>Imbibitions</b> – Objects of imbibitions, Types of imbibitions, Hot and cold water for imbibitions, Its Merit and demerit, Imbibition control system</p>	15

### Reference Books:

- 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 – M Axwell
- 6] Standard Fabrication Practices Of Cane Sugar Mill – Delden.
- 7] The Energy Cane Alternative – Alexander
- 8] Cane Sugar Manufacturing In India - D.P. Kulkarni

**M.Sc.(Sugar Technology)Part – I (Semester-I)**

**Paper- IV (CC)Chemical Control (ST1.4)**

<b>Unit</b>	<b>Syllbus</b>	<b>Lectures</b>
I	Technical definition millandboiling house Fundamental formulamill andboilinghouse	15
II	<b>Calculation for mill house</b> Differentialmethodforcalculation of Brix%Bagasse,fibre %Bagasse,added water % fibre Inferentialmethodforcalculationofmixedjuice% cane, Bagasse %cane,added water %caneetc. Clarificationof some concepts likejava ratio,E.R.Q.V,B.F.C.W.etc.	15

	Primary Extraction, Secondary Extraction, Mill Extraction, reduced mill extraction and whole mill extraction	
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	<b>Calculation for boiling house</b> Recorded boiling house recovery, Theoretical boiling house recovery, 0 Ideal boiling house recovery, Boiling house recovery (ESG), Reduced boiling house recovery (GUNDURAO), Overall recovery, Reduced overall recovery, Control parameters and norms for efficiency	15

**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. Prisen Geerligs.
- 3) International Commission For Uniform Method Of Sugar Analysis - ICUMSA Publication

**M.SC PART-I (SEMESTAR-II)**

**Paper-I(SC) Sugar Chemistry (ST2.1)**

**Syllbus**

Classification, structure, physical properties, reaction of Glucose and fructose (with organic and inorganic acids) and thermal decomposition

Formation in plants and nutrition, Physical properties (aqueous solution), Chemical properties (hydrolysis, oxidation, reduction, alkaline, acidic and thermal degradation), Enzymic and polymerization products. Polysaccharides – cellulose, starch and dextran

Mechanism of crystal growth, rate of crystallization (diffusion, viscosity, colloids, crystallographic control) of sucrose

**acids** – Distribution of Nitrogen in cane, Classification & general properties, proteins & amino acids of sugar cane  
Processing – Maillard reaction, thermal decomposition, suppression of heat transfer etc.

nitrogenous and non nitrogenous non sugars in cane.

– Coloring matter present in sugarcane—chlorophyll, flavonoids, and other compounds developed in process—caramel, Hexose degradation products, maillard reaction products, Colorimetry.

I— Theory of adsorption, adsorption of coloring matter, use of activated carbons. Ion Exchange resins, application in sugar industry

– Structure, Physical and Chemical properties, Uses of sucrose, food applications, fermentation feedstock, pharmaceutical applications, nutrition and health aspects and metabolism of sucrose

– standards and definitions, physical methods of sugar analysis, Polarimetry, Refractometry, enzymatic methods, chromatographic methods, NIR, determination of other components; impurities, particle size distribution, insoluble matter

**& Sugar Alcohols** –Ethers: – Triethyl ethers, methylethers, other alkyl ethers, silyl ethers, cyclic acetals, fatty acid esters, other carboxylic esters, derivatives, anhydrides & epoxides, nitrogen containing compounds, sulphur containing compounds, oxidation compounds, polymeric intermediates.

Alcohols:- Occurrence, Physical & Chemical properties, anhydration, esterification, etherification, reduction, metal complexes, isomerization, manufacture of sorbitol, mannitol & xylitol

### Reference Books:

- 1) Organic chemistry—Hendrick, Cram, Hammond.
- 2) Organic chemistry—Morrison & Boyd
- 3) Organic chemistry—Finer I.L
- 4) Organic chemistry—Pine
- 5) Advance Organic chemistry—Sachin Kumar Ghosh.
- 6) Advance Organic chemistry—B.S. Bahl & Arun Bhai
- 7) Principle of sugar technology –P. Honig

**M.Sc. Part – I (Semester - II)****Paper: II (SP-CF) - Sugar Processing – Crystallisation & Finishing (ST2.2)**

<b>Unit</b>	<b>Syllabus</b>	<b>Lectures</b>
I	<b>Theory of crystallization</b> & its zones, Grain & graining methods, Principles & practices in graining process, Mechanism of panboiling, Different massecuite boiling scheme, Principles and practices in panboiling.	15
II	<b>Construction of pan</b> , Types of pan, Pan control & instrumentation, 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 factors affecting exhaustion	15
III	<b>Centrifugal theories</b> , Centrifugal forces, Mean equivalent radius, Gravity factor, Time cycle, Capacity of basket, Moment of inertia, Power requirement, Constructions of batch machine, types of drive and control, Constructions of continuous machine types of drive and control	15
IV	<b>Centrifugal operations</b> - Screen washing, Sugar washing, Massecuite charging, Separation of light and heavy molasses, Spinning and drying, Discharging Super heated wash water system Sugar melter capacity, control system for temperature & Brix Pug mill, magma & run off tank. Molasses weighing scale construction, operation Theory of drying & cooling Drying and cooling of sugar on hopper, fluidized bed drier, Rotary drier Grading of sugar, packing of sugar Stitching and weighing of sugar Keeping quality of sugar, storage of sugar Specification of sugar as per IS standard. Construction of godown & storage of molasses Sugar handling & transporting system	15



**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 ChiChou
5. Manufacturing And Refining Of Raw Sugar–Baikow
6. By Product Of Cane Sugar Industries –Paturau
7. Cane Sugar Hand Book–R. B. L.Mathur
8. Cane Sugar Manufacturing In India–D. P.Kulkarni
9. Hand Book Of Cane Sugar–E.Hugot
10. Cane Sugar Engineering–PeterRain

**M.SC PART-I(SEMESTAR-II)****Paper: III-(SESP) Sugar Engineering-I –Steam& Power Generation (ST2.3)**

Unit	Syllabus	Lectures
I	<b>Steam Generation:(Boiler)</b> - Properties of steam, Fuel (Bagasse) , characteristics of Bagasse, combustion Bagasse, Furnaces (Spreader Stoker & Travelling Grate), Boiler mountings : stop valve, Safety valve, blowdown valve water level gauge glass, Boiler accessories: Super heater, Economizer, Air preheater, Boiler feed water tank & pump dearitor I.D, F.D. & S. A f a n s , Chimney, electrostatic precipitator etc.	15
II	<b>Boiler Instrumentation &amp; Control</b> - Various flow meters to measure flows like steam, feed water, Level indicator for Drum water, Pressure indicator for steam pressure, Temperature indicator for various points, All these points to be connected to data logger for recording	15
III	<b>Boiler water treatment</b> - Use of condensate, Feedwater specification and treatment (Internal & External), DM & RO Plants, analytical control	15
IV	<b>Power generation and Alternator</b> a) Power generation – Classification, description & working of extraction & double extraction cum condensing and fully condensing type turbines, specific steam consumption b) Alternator – sugar factory requirements, size, type, voltage, power factor & efficiency, 3 phase AC generation, and power transmission system.	15

**Reference Books:**

- 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 MillingOfSugar Cane–Maxwell
- 6) StandardFabricationPracticesOfCaneSugar Mill–Delden.
- 7) The Energy Cane Alternative–Alexander
- 8) Cane SugarManufacturingInIndia–D.P.Kulkarni

### M.ScPART-I (SEMESTAR-II)

#### Paper: IV-( EDD) EquipmentsDesign And Drawing (ST2.4)

Unit	Syllbus	Lectures
I	<p><b>a) Juice heaters</b> - Heat transfer coefficient, Heating surface, Sizing of heater, Tube sizeand numeroftubes,No of passes and juice inlet/outlet sizes, Constructionofjuiceheater.</p> <p><b>b)Juice Sulphitor</b> - Factors usedtodesigncontinuousjuice sulphitorreactiontank, Limeproportioningdevice (limes dosing), SO<sub>2</sub> gas distribution (So<sub>2</sub>gasdosing),Mechanical stirrerformixingofreagent, Design of tank with respectof diameter, AutomationforpH control, Construction of continuousjuice sulphitor</p>	15
II	<p><b>a)SulphurBurners/Furnace</b> - Combustionprocess of sulphur, Quantityofairrequired, Capacity ofsulphurburner, Construction ofsulphurburner</p> <p><b>b)JuiceClarifier</b> - Type of clarifier, Functional theory of operation, RetentionTime, Flash Tank, Capacity ofClarifier, Constructionofclarifier</p>	15
III	<p><b>a)Evaporator</b> - Heat transfer &amp; Evaporation coefficient, Heating Surface,Tube size andnoof tubes, Juice/syrup inlet-out letconnection, Sizing Triple/Quadruple/Quintuple,Steamrequirement</p> <p><b>b) Syrup sulphitor</b> - Factors used to design syrup sulphitor, Design of syrup sulphitor withrespectiveto diameter, AutomationforPhcontrol, Specification and construction of syrup sulphitor</p>	15
IV	<p><b>a)Pan</b> - Importantrequirementofpan boiling usedto designbatch pan, Different design of batchpan, The majordesign aspectsused in continuouspan, Different design of continuouspan, pan capacity and heatingsurface, Constructionofpan,</p> <p><b>b) Crystallizers</b> - Horizontal v/sVerticalcrystallizers, Capacity</p>	15

	<p>of crystallizer, Various zones and their retention time in cooling process, Quantity of water required for cooling</p> <p>c) <b>Centrifugals</b> - Gravity factor, Type of screen, Masecuite 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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- 3) Machinery&EquipmentsOfSugarFactory–L.A.Tromp
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- 7) The Energy Cane Alternative–Alexander
- 8) Cane Sugar Manufacturing In India - D.P.Kulkarni

## Syllabus of Practical Courses - M.Sc. Sugar

### Technology SEMESTER I

(STP1.1)

#### 1) SUGARCANE AGRICULTURE

- 1) Study of external morphology of sugarcane plant.
- 2) Study of internal morphology of sugarcane plant- T. S. of root,
- 3) Study of internal morphology of sugarcane plant- T. S. of stem
- 4) Study of internal morphology of sugarcane plant- T. S. of leaf.
- 5) Determination of soil pH (Any suitable method).
- 6) Study of soil texture
- 7) Determination of humus content (fertility) of the soil sample
- 8) Study of deficiency symptoms of macronutrients (N, P, K) in sugarcane plant. (Demonstration)
- 9) Study of sugarcane diseases-red rot, whip smut, leaf scald.
- 10) Study of sugarcane diseases red strips, mosaic and grassy shoot.
- 11) Study of sugarcane pests-termites, shoot borer, white flies and armyworms
- 12) Study of different types of fertilizers. (Demonstration)

### Reference Books:

- 1) Plant propagation – Hartman and Kester's
- 2) Principles and practices – Hudson T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. Robert L. Geneve.
- 3) Textbook of Plant Physiology – C. P. Malik.
- 4) Diseases of Crop Plants in India– G. Rangaswami and A. Mahadevan
- 5) Plant Pathology– R.S. Mehrotra
- 6) Practical cytology – Applied Genetics and Biostatistics– H.K. Goswami and Rajeev Goswami.

## 2) SUGAR TECHNOLOGY-I (Routine analysis)

- 1) Preparation of indicator solutions and test papers for pH determination of – Raw Juice (Methyl Orange) & Sulphited Juice (Bromothymol Blue)
- 2) Determination of pH of given sample by test paper and PH meter.
- 3) Determination of total dissolved solids (Brix) of given sample of juice by Hydro meter and hand refractometer.
- 4) Determination of apparent Purity of given sample of juices. .
- 5) To determine the purity of given sample of syrup and molasses.
- 6) To determine the purity of given sample of Massecuite
- 7) To determine purity of final molasses
- 8) To determine pol % and moist. % of Bagasse.
- 9) To determine pol % and moist. % of filter cake.
- 10) To determine sucrose of juice by –
  - a) double polarization method (Jackson & Gilis)
  - b) Fehling's method.
- 11) To determine reducing sugar of juice by –
  - a) Eyon and lane method
  - b) Luff's method
- 12) To determine sucrose of final molasses by
  - a. double polarization method (Jackson & Gilis)
  - b. Fehling's method.
- 13) To determine reducing sugar of final molasses by
  - a. Eyon and lane method
  - b. Luff's method
- 14) To determine total reducing sugar of final molasses.
- 15) To determine viscosity of final molasses by viscometer.

### 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. Prisen Geerligs.
- 3) International Commission For Uniform Method Of Sugar Analysis - ICUMSA Publication

### M.Sc. Part – (Sugar Technology) SEMESTER II (STP – 2.1)

#### 1) Sugar Chemistry

- 1] Analysis of white sugar for
  - a) Moisture (loss on drying)
  - b) Pol % by polarimeter
  - c) Sucrose by Jackson & Gillis
  - d) Reducing sugar by Ofner method
  - e) Ash (sulphated & conductivity )
  - f) Grading of sugar in term of ISS
- 2] Analysis of raw sugar for
  - a) Moisture (loss on drying)
  - b) Pol % by polarimeter
  - c) Sucrose by Jackson & Gillis
  - d) Reducing sugar by Ofner method
  - e) Ash (sulphated & conductivity )
  - f) Color in solution
  - g) Grain size by test sieve.

- 3) Analysis of Jaggery for
  - a) Moisture (loss on drying)
  - b) Pol % by polarimeter
  - c) Reducing sugar
  - d) Net Rendement
- 4) Determination of melting point of sucrose and boiling point of different concentrations on sugar solutions
- 5) The Determination of Insoluble Matter in White Sugar The Determination of the Particle Size Distribution of White Sugar by sieve method
- 6) Analysis of raw and white sugar for color by MOPS method.
- 7) To determine sulphur dioxide ( $\text{SO}_2$ ) in sugar.
- 8) To determine flock test by Coca Cola method.

**Referene 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. Prisen Geerligs.
- 3) International Commission For Uniform Method Of Sugar Analysis - ICUMSA Publication

**SUGAR TECHNOLOGY –II (SPECIAL ANALYSIS)**

- 1) To determine pol % cane by direct & indirect method
- 2) To determine fiber % cane by direct and indirect method.
- 3) To determine of recovery % cane by lab crusher method.
- 4) To determine preparatory index of prepared cane.
- 5) To determine mill performance by Brix curve method.

- 6) To determine mud volume of juice by heating, liming & addition of flocculants.
- 7) To determine optimum pH of shock liming for good clarification.
- 8) To determine  $\text{SO}_2$  content in syrup.
- 9) To determine size of crystal in slurry/seed/massecurite. By microscope.
- 10) To determine crystal % massecurite by purity and lab centrifugal machine.
- 11) To determine phosphate content of juice by
  - a) Ammonium molybdate method.
  - b) Uranium acetate method..
- 12) To determine CaO content of juice by
  - a) EDTA method
  - b) Ammonium oxalate method.
- 13) To determine sulphated Ash of juice,
- 14) Analysis of boiler water for
  - a) TDS
  - b) Hardness
  - c) Alkalinity.
  - d) Dissolved oxygen.
  - e) Chlorine.
- 15) Analysis of effluent for
  - a) Total solids
  - b) Total suspended solids
  - c) Total dissolved solids
  - d) Bio-chemical oxygen demand
  - e) Chemical oxygen demand

**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. Prisen Geerligs.
- 3) International Commission For Uniform Method Of Sugar Analysis - ICUMSA Publication

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