

 <p>Estd. 1962 "A" Accredited by NAAC(2021) With CGPA 3.52</p>	<p align="center"><b>SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA</b> PHONE : EPABX – 2609000, www.unishivaji.ac.in, <b>bos@unishivaji.ac.in</b> <b>शिवाजी विद्यापीठ, लिहापूर - ४१६००४, महाराष्ट्र</b> दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दूरध्वनी विभाग २३१-२६०९०९३/९४</p>	
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SU/BOS/Science/ 71

Date: 15 / 11 / 2022

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

**Subject :- Regarding syllabi of M.Sc. & B. Sc. Part- I (NEP-2020) degree programme under the Faculty of Science and Technology as per National Education Policy 2020 .**

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 syllabi and Nature of question paper of **M.Sc. & B. Sc. Part -I** under the Faculty of Science and Technology as per **National Education Policy 2020 .**

Sr.No.	Faculty of Science and Technology	Programme/ Course
1	Chemistry and Chemical Engineering	M.Sc. Part-I Alcohol Technology (Entire)
		M.Sc. Part-I Sugar Technology (Entire)
		M.Sc. Part-I, AGPM,
		B.Sc. Part-I Sugar Technology (Entire)

This syllabi and nature of question paper shall be implemented from the Academic Year **2022-2023** 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) (students Online Syllabus)

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

Thanking you,

Yours faithfully,



Dy Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre (I.T.)
4	B.Sc. Exam	10	Affiliation Section (U.G.)
5	Eligibility Section	11	Affiliation Section (P.G.)
6	O.E. I Section	12	P.G.Admission Section

**SHIVAJIUNIVERSITYKOLHAPUR**



**CHOICE BASED CREDIT SYSTEM**

**Syllabus**

for

**M.Sc.Part-I**

**Sugar Technology(Entire)**

(UnderFacultyofScience&Technology)

**AS PER NEP - 2020**

(TobeimplementedfromAcademicYear2022 - 23)

**M.Sc. Programme structure (CBCS pattern) (2022 -  
23)M.Sc.PartI**

<b>SEMESTER-I(Duration-SixMonth)</b>											
	Sr. No.	CourseCode	TeachingScheme			ExaminationScheme					
			TheoryandPractical			UniversityAssessment(UA)			InternalAssessment(IA)and Practical		
			Lectures (Perweek)	Hours (Perweek)	Credit	Maximum Marks	Minimum Marks	Exam.Hours	Maximum Marks	Minimum Marks	Exam. Hours
<b>CGPA</b>	1	CC101	4	4	4	80	32	3	20	8	1
	2	CC102	4	4	4	80	32	3	20	8	1
	3	CC103	4	4	4	80	32	3	20	8	1
	4	CC104	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-SixMonth)</b>											
<b>CGPA</b>	1	CC201	4	4	4	80	32	3	20	8	1
	2	CC202	4	4	4	80	32	3	20	8	1
	3	CC203	4	4	4	80	32	3	20	8	1
	4	CC204	4	4	4	80	32	3	20	8	1
	5	CCPR 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>• Studentcontact hoursper week:<b>32Hours</b>(Min.)</li> </ul>	<ul style="list-style-type: none"> <li>• TotalMarksforM.Sc.-I :<b>1200</b></li> </ul>
<ul style="list-style-type: none"> <li>• TheoryandPracticalLectures :<b>60Minutes</b>Each</li> </ul>	<ul style="list-style-type: none"> <li>• TotalCreditsforM.Sc.-I (SemesterI&amp;II) :<b>48</b></li> </ul>
<ul style="list-style-type: none"> <li>• CC-CoreCourse</li> <li>• CCPR-CoreCoursePractical</li> <li>• AEC-MandatoryNon-CGPAcompulsoryAbilityEnhancementCourse</li> <li>• SEC-MandatoryNon-CGPAcompulsorySkillEnhancementCourse</li> </ul>	<ul style="list-style-type: none"> <li>• PracticalExaminationisannual.</li> <li>• ExaminationforCCPR-105shallbebasedonSemesterIPracticals.</li> <li>• ExaminationforCCPR-205shallbebasedonSemesterIIPracticals.</li> <li>• *DurationofPracticalExaminationasperrespectiveBOSguidelines</li> <li>• <i>Separatepassing is mandatory for Theory, Internaland PracticalExamination</i></li> </ul>

**M.Sc.Programmestrucre(CBCSPATTERN)(2022-  
23)M.Sc.Part-II**

<b>SEMESTER-III(Duration-SixMonth)</b>											
	Sr. No.	CourseCode	TeachingScheme			ExaminationScheme					
			TheoryandPractical			UniversityAssessment(UA)			TheoryandPractical		
			Lectures (Perweek)	Hours (Perweek)	Credit	Maximum Marks	Minimum Marks	Exam.Hours	Maximum Marks	Minimum Marks	Exam. Hours
<b>CGPA</b>	1	CC301	4	4	4	80	32	3	20	8	1
	2	CC302	4	4	4	80	32	3	20	8	1
	3	CC303	4	4	4	80	32	3	20	8	1
	4	CC304	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)	NumberoflecturesandcreditsshallbeasspecifiedonSWAYAM MOOC								
<b>SEMESTER-IV(Duration-SixMonth)</b>											
<b>CGPA</b>	1	CC401	4	4	4	80	32	3	20	8	1
	2	CC402	4	4	4	80	32	3	20	8	1
	3	CC403	4	4	4	80	32	3	20	8	1
	4	CC404	4	4	4	80	32	3	20	8	1
	5	CCPR 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 (SWMMOOC)-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>

<b>Total Credits for M.Sc. Program: 96</b>
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<b>Total Marks for M.Sc. Program: 2400</b>
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### 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>Titleofcourse</b>	
CGPA	CC101	I	ST 1.1	SugarcaneAgriculture	All coursesarec ompulsory
	CC102	II	ST 1.2	Sugar Processing – clarification&evaporation	
	CC103	III	ST 1.3	Sugarengineering–Milling	
	CC104	IV	ST1.4	ChemicalControl	
	CCPR105		STP1.1	Practical – I	
Non CGPA	AEC106				

**M.Sc. Part I (Sugar  
Technology)Sem-II**

	<b>Course code</b>	<b>Paper No.</b>		<b>Titleofcourse</b>	
CGPA	CC201	V	ST2.1	SugarChemistry	All coursesarec ompulsory
	CC202	VI	ST2.2	Sugar Processing – Crystalization&finishing	
	CC203	VII	ST2.3	Sugar engineering – steam &powergeneration	
	CC204	VIII	ST 2.4	EquipmentDesign&drawing	
	CCPR205		STP2.1	Practical – II	
Non CGPA	SEC206				



# 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 2022-23

## 3 Preamble/Introduction

In India sugarcane becomes industrial crop and sugar industry becomes an integrated cane processing unit where 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 an 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 Graduate 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 course under science & Technology faculty, accordingly we are running B.Sc (Sugar Technology) course since last five academic years. Due to growing demand from industries we wish to start M.Sc. (Sugar Technology)

#### **4. General objectives of the course. Objectives:**

##### **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 be also 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 exist 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/chemicaltechnology)  
 B.E.Chemical  
 engineering/Instrumentation/Mech  
 anical Engg.

**10) Medium of instruction:**

The medium of instructions shall be in English

**11) Teachers Qualification:**

ANSI/AVSI(SugarTech,)ANSI/AVSI(SugarEngg.)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.DBE/ME(Electronics/Instrumentati

on)

BE/ME(Mechanical)

BE/ME(Chemical)

**12) Structure of course:**

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

**(Theory – 4 paper) Semester –**

**1 Theory**

Sr.No	Theory – core-Subject	Code	Credits	Marks
1	Sugar Cane Agriculture	SCA	4	100
2	Sugar processing – Clarification & Evaporation	SPCE	4	100
3	Sugar engineering – milling	SEM	4	100
4	Chemical control	CC	4	100
5	Total		16	400

**Semester 1- practical's**

Srno	Practical Subject	Code	Credits	Marks
1	Sugar Cane Agriculture	SCA	4	100
2	Sugar technology – I	ST – I	4	100
3	Total		8	200

## Semester 2-Theory

Sr.no	Theory –coresubject	Code	Credits	Marks
1	SugarChemistry	SC	4	100
2	Sugar processing – Crystallisation&finishing	SPCF	4	100
3	Sugarengineering – steam&powergeneration	SESPG	4	100
4	Equipmentdesignanddrawing	EDD	4	100
5	Total		16	400

## Semester2-practical's

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

## Semester–3Theory

Srno	Theory–core/elective	Code	Credits	Marks
1	Equipmentcapacity Calculation	ECC	4	100
2	AlliedSugarManufacturing	ASM	4	100
3	Chemicalengineering-heat andmomentumtransfer	CEHMT	4	100
4	Elective: 1) Alcoholtechnology 2)Bio-ChemicalEngineering 3)Electronic andinstrumentationengineer ing	ET:1 )AT 2) BCE 3) EIE	4	100
5	Total		16	400

### Semester-3 Practical's

Sr.No	Practical-subject	Code	Credits	Marks
1	Sugar technology-III	ST-III	4	100
2	Practical on elective subject	ET(P)	4	100
3	Total		8	200

### Semester 4-theory

Sr.	Theory-core/elective	Code	Credits	Marks
1	Allied Co-products Manufacturing	ACM	4	100
2	Advance Sugar Technology & Engineering	ASTE	4	100
3	Chemical engineering - unit Operation	CEUP	4	100
4	Elective: 1) Energy conversion and cogeneration 2) Pollution prevention and control 3) Water management and zero discharge	ET:1) ECC 2) PPC 3) WMZD	4	100
5	Total		16	400

### Semester-4 Practicals

Sr.No	Practical Subject	Code	Credits	Marks
1	Technical essay on Elective Subject (Self Study)	TE	2	50
2	Plant Training (project Report)	IT	6	150
3	<b>Total</b>		<b>8</b>	<b>200</b>

### 13) Scheme of teaching and Examination

The scheme of teaching and examinations should be given as applicable to the course/paper concerned.

#### A) Teaching:

Teaching consists of lectures followed by term work and

practical's/Tutorials. There are 4 papers of 100 marks at end of each semester. and 2 practical's/Tutorial of 100 marks each at end of each semester.

**B) Examination:**

This semester examination will be conducted at the end of each term for theory and practical.

Theory paper will be of 80 marks each and 20 marks for internal evaluation test conducted in the mid of the term.

Practicals will be of 80 marks. and 20 marks reserve for presentation of practical logbook .

Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

**14) Standard of passing**

As per rules and regulation of M.Sc. course.

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

Theory question paper (Maximum marks –

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**

S.R.	Old Subject	S.R.	New Subject
1	Sugarcane Agriculture	1	Sugarcane 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>OldSubject</b>	<b>S.R.</b>	<b>NewSubject</b>
1	SugarChemistry	1	SugarChemistry(ST2.1)
2	SugarProcessing–Evaporation	2	Sugar Processing – Crystallisation& finishing(ST2.2)
3	Sugar Engineering – Steam &powergeneration	3	Sugar Engineering – Steam &powergeneration(ST2.3)
4	Equipmentdesign&drawing	4	Equipmentdesign&drawing( ST2.4)

### **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**

Unit	Syllabus	Lectures
I	<p><b>Introduction:</b> Origin of Cane, cultivation in India, varieties, climatic conditions, sugarcane agroclimatic zones in India. Sugarcane pricing and payment,</p> <p><b>Soil:</b> Types, properties – Visual &amp; morphological properties, analytical properties, fertility &amp; soil problems, sustaining fertility, soil conservation practices,</p> <p><b>Planting:</b> Preparatory tillage, planting time, selection of seedcane, methods of planting - Flat, ridges &amp; furrows, trench, IISR 86206, ring, spaced Transplanting &amp; polybag seedling Transplanting method.</p> <p><b>Growth of Sugarcane:</b> Germination, development of shoot &amp; root - factors affecting, tillering, growth of leaves, internodes &amp; stem, factors influencing cane growth, formation and storage of sugarcane.</p>	15
II	<p><b>Irrigation:</b> Water requirement, scheduling, method of irrigation – surface, overhead or sprinkler, drip irrigation, water quality, water logging, drainage – side, main &amp; in field drains.</p> <p><b>Manuring:</b> Cane nutrition, functions of macro &amp; micro (trace) nutrients, fertilizers – N, P, K, S, Ca &amp; Mg carriers, Mixed or compound fertilizers, biofertilizers, foliar applications, fertigation, organic &amp; green manuring, time &amp; method of application, visual symptoms of nutrient deficiency and disorders.</p> <p><b>Weeds:</b> Common weeds, aquatic weeds, losses due to weeds, methods of weed control – mechanical, manual, chemical (time, method &amp; dosage), integrated weed management, measures to reduce the weeds.</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 measures (chemical &amp; biological), losses due to pests &amp; diseases, plant protection measures</p>	15
III	<p><b>Ripening:</b> Methods of judging ripeness or maturity,</p>	15

	<p>factors affecting ripening, accelerating ripening, chemical ripeness.</p> <p><b>Harvesting:</b> Manual &amp; mechanical harvesting of cane, transportation of cane, postharvest deterioration of sugar cane—causes, effect &amp; losses, effect of extraneous</p> <p><b>Ratooning:</b> Definition, yield &amp; quality, number of ratoons, advantages and disadvantages, area and productivity, causes for low ratooning, tillering, varieties for good ratoons, removal of compaction, gap filling, fertilizer application, water requirement</p>	
IV	<p>Breeding technique in sugarcane, Introduction, varieties, scope of varietal planting, cytology, Raising of seed cane crop— Ideal seed cane, seed cane treatment, measures to obtain higher germination, transplanting technique and its advantages, Breeding Methods Introduction and germ plasm collection, Clonal Selection, Hybridization. Mutation breeding, Objectives of sugarcane breeding, Breeding for yield, lodging resistance, resistance to frost, resistance to drought, resistance to water logging, resistance to diseases, resistance to insect pests and quality.</p> <p>Sugarcane breeding institutes in India. Physiology of sugarcane under normal condition, Physiology of sugarcane under normal saline condition, Rapid screening parameters for salt stress, Agro-technology to improve germination under saline condition, Work on the physiology on various sugarcane clones.</p>	

### Reference Books:

- 1) Hartmann and Kester's – Plant propagation – Principles and practices – Hudson T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. Robert L. Geneve.
- 2) Textbook of Plant Physiology – C.P. Malik.
- 3) Diseases of Crop Plants in India – G. Rangaswami and A. Mahadevan
- 4) Plant Pathology – R.S. Mehrotra
- 5) Practical cytology – Applied Genetics and Biostatistics – H.K. Goswami and Rajeev Goswami.
- 6) Recent Advances in Plant Diseases Vol-1 to 5 – K.M. Chandaniwala.
- 7) Introduction to Principles of Plant Pathology – R.S. Singh.
- 8) An introduction to Plant Anatomy – Authur R. Eames and Laurence H. MacDaniels.
- 9) Genetics and Plant Breeding – E.B. Babcock.
- 10) Plant Taxonomy – O.P. Sharma.
- 11) Plant Breeding – Theory and Techniques – S.K. Gupta.
- 12) Breeding Asian Field Crops – John Milton Poehlman and Dhirendranath Borthakur.
- 13) Crop Production and Field Experimentation – Dr. V.G. Vaidya, K.R. Sahasrabudhe, Dr. V.S. Khuspe.
- 14) Agricultural Problems of India – A.N. Agrwal and Kundam Lal.

**M.Sc.I-Sugar technology(Semester-1)**  
**Paper–IISugar Processing-Clarification&Evaporation**

Unit	Syllabus	Lectures
I	<p>Introduction of sugar industry &amp; flow chart of sugar manufacturing process, Extraction of juice from cane, Maceration or imbibitions and their scheme Mills sanitation and type of biocides used, Effects of fine bagasillo on juice clarification &amp; its separation, Equipments detail and operation of DSM screen &amp; Rotary screen, Weighing and metering of juice, Equipment detail and operation of Maxwell Boulogne scale and mass flow meter with calibration, Object of juice heating, Construction and working of vertical tubular juice heater, Removal of Condensate and non-condensable gas, Calculation of heating surface, Concept of vapor line and dynamic Juice Heater, Construction and working of DCH and PHE</p> <p>Basic chemical required for clarification, their specification. Preparation of milk of lime (MOL) and its equipment details. Separation of grit from MOL, Production of SO<sub>2</sub> gas by furnace Quantity of air required for burning, Equipment detail and operation of continuous &amp; film type furnace, Role of phosphate in juice clarification and its use</p>	15
II	<p>Composition of cane and juice, Principle of juice clarification, Influence of lime on different constituents of juice, Effects of pH on sucrose and reducing sugar, Action of heat on sucrose and reducing sugar, Different process of cane juice clarification, Defecation, Sulphitation and carbonation, Comparison between sulphitation &amp; carbonation, Principle of subsidation, Factors affecting the subsidation, Speed of subsidation Construction and operation of DORR multi feed clarifier, 444 Rapi clarifier, Importance of short ration clarifier, Its construction and operation, Preparation of settling chemical and its use, juice and mud removal</p> <p>Condition for good filtration, Preparation of mud, Construction and working of vacuum filter, Washing of cake, Mini condenser or vacuum pump, Quality of filtrate and its treatment, Decanter for muddy juice treatment, Advantages of decanter</p>	15
III	<p>Theory of evaporation – Introduction, quantity of water evaporated from juice, Heat transfer in evaporator, Boiling point of juice, Norbert Rolex principle applicable to multiple effect evaporators</p> <p>Construction of Robert type evaporator, Different types of evaporator body, Entrainment and entrainment separator Condenser and type of condenser, Quantity of water required for condensation, Vapor velocity and vapor piping</p>	15

IV	<p>Operation of evaporator, Off season testing of evaporator, Starting of evaporator, Juice level evaporator, Condensate and non-condensable gas removal, Flash recovery of condensate, Use of condensate, Stopping of evaporator</p> <p>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</p> <p>a) Treatment of syrup, Construction and working of syrup sulphitor, Scale formation and removal</p>	15
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**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) Handbook of sugar refinery chung chichou
- 5) Manufacturing and refining of raw sugar – Baikow
- 6) Byproduct of cane sugar industries Paturau.
- 7) cane sugar hand book R. B. L. Mathur
- 8) Cane sugar manufacturing in India D. P. Kulkarni

## M.Sc-ISugarTechnology(Semster-I)

### Paper:III-(SEM)SUGARENGINEERING--MILLING

Unit	Syllbus	Lectures
I	<p>Caneweighbridges:types,capacityetc.</p> <p>Cane handling and feedingCane unloading - Bridge with trolley – having sling bar system – two motion/three motion, auto de-hookingsystem</p> <p>Feeder table – size, slope, chain, breaking strength, powerconsumption,drive etc</p> <p>Cane carrier – horizontal &amp; inclined carrier, feedinglength, Width ofcarrier, Speed of carrier,capacity of carrier, power consumption ofcarrier, Types of carrier 1) single cane carrier 2)Split cane carrier.3)Rakecanecarrier 4)Belt carrier,Trampironsepetor.</p>	15
II	<p>Canepreparations</p> <p>Preparationofcane,</p> <p>various devices of cane preparation like kicker, chopper, leveler, cutterfibrizerandshredder</p> <p>Measurementofpreparationindexbybulkdensitymethod,sievingmethod,1 eachingmethod.</p>	15
III	<p>Millsandmillcomponents–Conventional threerollermill.</p> <p>MillHeadstocks,Millrollers&amp;rollersgrooving</p> <p>Grooving types – V–grooves, Messchaert grooves &amp; chevron grooveslotusroller,Millhydraulicsystem,Millbearings&amp;theirtypes</p> <p>Millrollerpinions,Trash&amp;Scrapperplates</p>	15
IV	<p>Mill drive types with merit and demerit, Mill power requirement, Millgearing,Millcouplingsandtailbars</p> <p><b>Mill setting</b> – Roller setting, pressure feeder setting, underfeed rollersetting,donelleychuteopening,trashplatesetting,practicaloptimizationofmillsetting</p> <p>Checkingofmillperformanceby Brixcurve</p> <p><b>Imbibitions</b>–Objectsofimbibitions,Typesofimbibitions,Hotandcold water for imbibitions, Its Merit and demerit,Imibibition controlsystem</p>	15

#### ReferenceBook.

- 1] Handbook of canesugar E.Hugot
- 2] Canesugarengineering PeterRain.
- 3] Machinery&equipments ofsugarfactory L.A.Tromp
- 4] canesugarhandbook R.B.L.Mathur

5] Modernmillingofsugarcane :Maxwell

6] standardfabricationpractices ofcane sugarmill Delden.

7]theenergycanealternative Alexander

8] Cane sugar manufacturing in  
IndiaD.P.Kukkarni

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

### Paper-IV(CC)CHEMICAL CONTROL

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 javaratio, 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, 0 Ideal boiling house recovery, Boiling house recovery (ESG), Reduced boiling house recovery (GUNDU RAO), Overall recovery, Reduced overall recovery, Control parameters and norms for efficiency	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. P. Prisen Geerligs.
- 3) International Commission for uniform method of sugar analysis — ICUMSA Publication

# M.SCPART-I (SEMESTAR-II)

## Paper-I(SC)SUGARCHEMISTRY

Unit	Syllbus	Lectures
I	<p><b>Carbohydrates–</b> Classification,structure,physicalproperties,reactionofGlucoseandfructose(withorganicandinorganicreagents),alkaline,acidic andthermaldecomposition</p> <p><b>Sucrose – Structure</b>, formation in plants and nutrition, Physicalproperties(aqueous,opticalelectrical),chemicalproperties(hydrolysis,oxidation,reduction,alkaline,acidicandthermaldegradation), sucroserivativesanduses,enzymicandpolymerization products.Polysaccharides – cellulose, starch anddextran</p> <p><b>Crystallization</b> – Mechanism of crystal growth, rate of crystallization(diffusion,viscosity,colloids,crystallographicconsiderations),crystallographyof sucrose</p>	15
II	<p><b>Proteins&amp;Aminoacids–</b> DistributionofNitrogenincane,Classification&amp;generalproperties,proteins&amp;aminoacidsofsugarcane and their behavior during processing – maillard reaction,thermal decomposition,suppression ofheattransferetc.</p> <p>Organic, inorganic, nitrogenous and non nitrogenous non sugars incane.</p> <p><b>Coloring Matter</b> – Coloring matter present in sugarcane – chlorophyll,flavonoids, anthocyanins as chlorants, colouring compounds developedin process – caramel, Hexose degradation products, maillard reactionproducts,Colorimetry.</p> <p><b>Colour Removal</b> – Theory of adsorption, adsorption of coloringmatter, use of activatedcarbons. Ion Exchange Resins – theory,regenerationofresins,applicationinsugarindustry</p>	15
III	<p><b>Sucrose–</b> Structure,PhysicalandChemicalproperties,Usesofsucrose,foodapplications,feedstockforchemicalsynthesis,fermentationfeedstock,pharmaceuticalapplications,nutritionandhealth aspectsandmetabolismofsucrose</p> <p><b>Sugar Analysis</b> – standards and definitions, physical methods ofsugar analysis, Polarimetry, Refractive index, colorimetric methods,enzymatic methods, chromatographic methods, NIR, determinationofothercomponents;moisture,ash&amp;inorganicconstituents,particlesizedistribution,insolublematter</p>	15
IV	<p><b>Sugar Derivatives &amp; Sugar Alcohols</b> – Ethers: – Triethyl ethers,methyl ethers, other alkyl ethers, silyl ethers, cyclic acetals. Esters: - Acetates,benzoates,fattyacidesters,othercarboxylicesters,sulphonate esters, deoxyhalogen derivatives, anhydrides &amp; epoxides,nitrogencontainingcompounds,sulphurcontainingcompounds , oxidation compounds from enzymatic isomerization, polymeric</p>	15



	intermediates. Sugar Alcohols: - Occurrence, Physical & Chemical properties, anhydration, esterification, etherification, acetal formation, oxidation, reduction, metal complexes, isomerization, manufacture of sorbitol, mannitol & xylitol	
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**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: Sachinkumar Ghosh.
- 6) Advance Organic chemistry: B.S. Bahl & Arun Bhai
- 7) Principle of sugar technology. P. Honig

<b>M.Sc.Part– I(Semester -II)</b>		
<b>Paper:II(SP-CF)-SugarProcessing–Crystallisation&amp;Finishing</b>		
<b>Unit</b>	<b>Syllabus</b>	<b>Lectures</b>
I	Theory of crystallization & its zones, Grain & graining methods, Principles & practices in graining process, Mechanism of pan boiling, Different massecuite boiling scheme, Principles and practices in pan boiling.	15
II	Construction of pan, 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, termination 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	Centrifugal theories, Centrifugal forces, Mean equivalent radius, Gravity factor, Time cycle, Capacity of basket, Moment of inertia, Power requirement, Construction of batch machine, types of drive and control, Construction of continuous machine types of drive and control	15
IV	Centrifugal operations - Screen washing, Sugar washing, Massecuite charging, Separation of light and heavy molasses, Spinning and drying, Discharging Superheated 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. Constriction 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. Handbook of sugar refinery, Chung Chi Chou
5. Manufacturing and refining of raw sugar, Baikow
6. Byproduct of cane sugar industries, Paturau
7. Cane sugar handbook, R. B. L. Mathur
8. Cane sugar manufacturing in India, D. P. Kulkarni
9. Handbook of cane sugar, E. Hugot
10. Cane sugar engineering, Peter Rain

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

### Paper: III-(SESP) SUGAR ENGINEERING- I –STEAM & POWERGENERATION

Unit	Syllabus	Lectures
I	<b>Steam Generation: (Boiler)</b> - Properties of steam, Fuel (Bagasse), characteristics of Bagasse, combustion Bagasse, Furnaces (SpreaderStoker & Travelling Grate),Boiler mountings :stop valve,Safety valve,blowdown valve water level gauge glass, Boiler accessories: Superheater, Economizer, Air preheater,Boiler feed water tank & pumpdearitorI.D,F.D.&S.Afans,Chimney,electrostaticparticipatoretc.	15
II	<b>BoilerInstrumentation&amp;Control-</b> Variousflowmetertomeasureflowslikesteam,feedwater,LevelindicatorforDrumwater,Pressureindicatorforsteampressure, ,Temperature indicator for various points, All these points to beconnectedto dataloggerforrecording	15
III	<b>Boiler water treatment</b> - Use of condensate, Feed waterspecificationandtreatment(Internal&External),DM&ROPlants,a nalyticalcontrol	15
IV	<b>PowergenerationandAlternator</b> a) Power generation – Classification, description & working ofextraction&doubleextractioncumcondensingandfullycondensingtyp eturbines, specific steamconsumption b)Alternator– sugarfactoryrequirements,size,type,voltage,powerfactor&efficiency, 3phaseACgeneration,andpowertransmissionsystem.	15

#### ReferenceBook.

- 1] Handbook of canesugar E.Hugot
- 2] Canesugarengineering PeterRain.
- 3] Machinery&equipments ofsugarfactory L.A.Tromp
- 4] canesugarhandbook R.B.L.Mathur
- 5] Modernmillingofsugarcane Maxwell
- 6] standardfabricationpracticesofcanesugarmill  
Delden.
- 7]theenergycanealternative,  
Alexander
- 8]CanesugarmanufacturinginIndia D.P.Kukkarni

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

**Paper:IV-(EDD)EQUIPMENTSDESIGNANDDRAWING.**

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> gas dosing), 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, Retention Time, Flash Tank, Capacity of Clarifier, Construction of clarifier</p>	15
III	<p>a) Evaporator - Heat transfer &amp; Evaporation coefficient, Heating Surface, Tube size and no of tubes, Juice/syrup inlet-outlet connection, Sizing Triple/Quadruple/Quintuple, Steam requirement</p> <p>b) Syrup sulphitor - Factors used to design syrup sulphitor, Design of syrup sulphitor with respect to diameter, Automation for Ph control, Specification and construction of syrup sulphitor</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 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, Masse cuite 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>	15

**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 R.B.L. Mathur

5] Modern milling of sugarcane

Maxwell

6]standardfabricationpracticesofcanesugarmill Delden.

7]theenergycanealternative,

Alexander8]Can

esugar manufacturinginIndia

D.P.Kukkarni

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

### **SEMESTER I**

#### **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, whipsnout, leaf scald.
- 10) Study of sugarcane diseases red strips, mosaic and grassy shoot.
- 11) Study of sugarcane pests- termites, shoot borer, white flies and army worms
- 12) Study of different types of fertilizers. (Demonstration)

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

- 1) Preparation of indicator solutions and test papers for pH determination of – Raw Juice (Methyl Orange) & Sulphated 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 Masecuite
- 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
  - i. double polarization method (Jackson & Gilis)
  - ii. Fehling's method.
- 13) To determine reducing sugar of final molasses by
  - a. Eyon and lane method
  - i. Luff's method
- 14) To determine total reducing sugar of final molasses.
- 15) To determine viscosity of final molasses by viscometer.

## SEMESTER II

### 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 terms 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 concentration 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 (SO<sub>2</sub>) in sugar.

#### 8) To determine flock test by Coccolam method.

## 2) 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 SO<sub>2</sub> content in syrup.
- 9) To determine size of crystals 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) Biochemical oxygen demand
  - e) Chemical oxygen demand