SHIVAJI UNIVERSITY

KOLHAPUR

Estd.:1962

NAAC 'A' Grade,

MHRD-NIRF-28th Rank

New Syllabus For

Master of Science (Sugar Technology)

Part - I (Semester –I, SemesterII & Practical's)

Syllabus to be implemented from June 2016 onwards

A] **Ordinance and Regulations:-**

B] **Shivaji University, Kolhapur**

New Syllabus For
Master of Science (Sugar technology)

1. Title : M.Sc. Sugar Technology

M.Sc.Part I New syllabus.

2 Year of implementation.

New syllabus will be applicable from June 2016

3 Preamble/Introduction

In India sugarcane becomes industrial crop and sugar industry becomes as integrated cane processing unit wherein sugar, alcohol, energy and allied products are manufactured thus it is needed to provide technologist 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. Recently Maharashtra govt. permitted to start such a carrier oriented courses under science faculty, according 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 objects of the course.

Objectives :

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

1) To develop the human recourse 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) course 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.

10) Medium of instruction:

The medium of instruction shall be in English

11)Teachers Qualification:

- ANSI/AVSI (Tech,) ANSI/AVSI (Eggs.)
- M.Sc (Chemistry with NET/SET) Or Ph.D
- M.Sc(Biochemistry With NET/SET) or Ph.D
- M.Sc(Agriculture with NET/SET) or Ph.D
- M.Sc(Sugar technology)/B.Tech(Sugar technology)
- BE/ME (Instrumentation)

12) Structure of-course:

M.Sc -(ST) First year (Theory -4paper)

Semester 1- Theory

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

Semester 1- practical's

Sr no	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 – core subject	Code	Credits	Marks
1	Sugar Chemistry .	SC	4	100
2	Sugar processing-evaporation.	SPE	4	100
3	Sugar engineering-steam &power generation.	SESPG	4	100
4	Equipment design and drawing.	EDD	4	100
5	Total		16	400

Semester 2- practical's

Sr no	Practical –subject	Code	Credits	Marks
1	Sugar chemistry.	SC	4	100
2	Sugar technology -II	ST-II	4	100

Semester 3-theory

Sr no	Theory – core/elective subject	Code	Credits	Marks
1	Equipments capacity calculation	ECC	4	100

2	Sugar processing-crystallzation .	SPC	4	100
3	Chemical engineering-heat and momentum transfer	CEHMT	4	100
4	Elective: 1) Alcohol technology 2)Bio-Chemical Engineering 3)Electronic and instrumentation engineering	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 3	ST-III	4	100
2	Practical on elective subject	ET(P)	4	100
3	Total		8	200

Semester 4-theory

Sr. No	Theory –core/elective subject	Code	Credits	Marks
1	Sugar processing-finishing	SPF	4	100
2	Raw and refine sugar production.	RRSP	4	100
3	Chemical engineering-unit operation.	CEUP	4	100
4	Elective: 1) Energy conversion and cogeneration 2) Pollution preventation 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	Theory	Code	Credis	Marks
1	Technical easy on Elective Subject (Self Study)	TE	4	100
2	In plant Training(project Report)	IT	4	100
3	**Total**		**8**	**200**

13) Scheme of teaching and Examination

The scheme of teaching and examination 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.

• The 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 log book .

• 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 question 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 the section. Both sections are to be written in the same answer book.

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

New syllabus hence not applicable

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:30

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. 8
- . 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 e 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.

20) Credit system (Applicable to University department)

Credits can be defined the work load of a student in

1. Lectures

2. Practical's

3. Seminars

4. Private work in the Library/home

5. Examination

6. Other assessment activities

How much time a student gives for the examination per semester?

1) 4 Theory papers per semester each of the three hour duration. Time required is(4x3)= 12 hours

2) 2 Practical's per paper with 2 experiments per practical. Total 4 practical each of 3 hour duration. Time required is 12 hour. Total time for a semester examination is 12 + 12 = 24 hrs

Time required for the other activities.

Seminars-as per the requirement of the course (minimum 2, One for each semester)

Library-book issue, Journal reference, reviews writing of research papers, internet access. Reading magazines and relevant information

Private work – project material, Industrial training, book purchase, Xerox,availing outside facilities etc

Home- Study, notes preparations, computations etc

Types of Credits

1) Credits by examination- test (theory and practical) 9

2) Credits by non examination- Proficiency in the state, national and

International sports achievements, project, Industrial training, and participation

in workshop, conference, symposia etc Social service (NSS) Military service (NCC) Colloquium & debate, Cultural programs etc

Credits by lectures and Practical's

• Total instructional days as per the UGC norms are 180.

• 1 credit is equivalent to 15 contact hours

• For the M Sc course there are 4 theory papers with 4 hours teaching per week

Therefore the instructional days for the theory papers in semester are 4 x

15(weeks) = 60

• There are 4 practical's (with 1 project) each of 6 hour duration for the 2 practical courses.

Total practical workload is 12 hours per week. Thus instructional days for the practical course of 4 practical's are 2 (practical papers) x 15 = 30

The time for each student is busy in a semester is 90 days (Theory) + 60 days (Practical) = 150 days

• With 4 credits per theory paper will be 4 x 4=16 credits and 4 credits per

practical will be 4 x 2= 08 credits

Credits for the practical's

Every practical (project) of 50 marks carries 2 credits.

Number of credits for M Sc course per semester will be 16 + 8 = 24. Total

No .of credits for entire M Sc course will be 4 x 24 = 96.

There will be 4 credits for other assessment activities-

Total credits for entire M Sc course will be

Theory course, 4 credits x 16 = 64

Practical course, 4 credits x 8 = 32

Other activities 4 credits = 04

Total = 100 credits

How to restructure the M. Sc course implementation of the credit system?

There will not be a major change in the restructured course. However some minor modification can be made in the syllabus wherever necessary.

In order to implement the credit system effectively it is necessary to make every semester duration of at least 12 weeks.

The examination must be scheduled in one month's time

The students must get at least 3 weeks time for the examinations preparations.

Every theory papers syllabus should consists of 4 units (sub units allowed) each carrying 1 credit. 10

In order to have uniformity in the credit transfer it is necessary to have internal examination in all the P.G. departments of equal weight age. 80 external + 20 internal appears to be ideal to begin with.

Theory paper	**contact hours**	**credits**
Unit-1 (sub units if any)	15	1
Unit-2(sub units if any)	15	1
Unit-3 (sub units if any)	15	1
Unit-4(sub units if any)	15	1

The practical course credit distribution

Practical paper	**Practical**	**Contact hours**	**Credits**	**no of practical's**
I (Unit-1)	1	6	2	12
I (Unit-1)	2	6	2	12
II (Unit-1)	3	6	2	12
II (Unit-1)	4	6	2	12

A project of 50 marks will be carrying 2 credits. Where a project of 50 marks is offered to the student, the student will have to perform 1 project, 1 practical paper (2 practical) for that semester. Time for the explanation for the practical course (contact ours) will be 1 week (12 hours).

This makes the practical workload of the student equal to 60 days in a semester.

Grades, grade point and average grade point's calculations

Table showing the grades, grade points and marks scored by a student

Grades	Grade points	marks out of 100
A+	9	91 to 100

A	8	81 to 90
A-	7	71 to 80
B+	6	61 to 70
B	5	51 to 60
B-	4	41 to 50
C+	3	31 to 40
C	2	21 to 30
C-	1	11 to 20
F	0	0 to 10

Sum grade point average SGPA):- It is a semester index grade of a student

1. SGPA = (g1xc1) + (g2xc2) + -------- + (g6xc6)/ Total credits offered by a student in a semester.

2. Cumulative grade point average (CGPA):- It is cumulative index grade point average of student

CGPA = (g1xc1) + (g2xc2) + -------- + (g6xc6)/Total no of credits offered by students up to and including semester for which the cumulative average is required.

3. Final grade point average (FGPA): - It is a final index of student in the course FGPA=(n/∑ci x gi) /(n/ cl) Where c1- credit of the course (paper) (4)

gi – grade point secured (see the table for conversion)

n- No of courses (no of paper offered)

cl- Total no credits for the entire M Sc course (100)

Illustration with an hypothetical case

For M Sc I (or II/III/IV)

1 papers	I	II	III	IV	Practicals	I	II	III	IV
2 credits	4	4	4	4		2	2	2	2 = 24
3 grade point	7	6	8	6		7		7	= 41

Obtained

4 ∑ ci x gi 28 24 32 32 28 28 = 164

5 ∑ ci x gi/cl =164/24 = 6.83

6 Overall grade = 6.83

The cumulative grade point average is the sum of SGPA of student of every semester.

Suppose it is 164(6.83) for semester- I, 170(7.08) for semester -II, 168 (7.0) for semester III and 176 (7.33) for semester IV.

The cumulative average for semester I and II will be = 334/48 = 6.958 = 6.96

Final grade point average for all semesters = 678/96 = 7.0265 = 7.03

Rules for opting the credits

1. A student from same department only will be eligible for opting the specialization of the choice.

2. It will be mandatory for a student admitted for a specialization to opt for the papers related to that specialization Other papers can not be offered as credits in lieu of these papers

3. Admission to the students from the other specialization for the credits will be restricted to 5 core papers only. A student from other department will be offered credits of his choice in multiples of 4. A theory paper can be offered as the credit. However number of such admissions will depends upon the seats available class room seating capacity.

4. Any student can have credits from the management course. In order to increase the employability of the students it is necessary that add on course in management be offered by the department of management. Separate fees can be charged from the students for taking this course. Such course can be arranged during the vacation.

M.SC PART-I (SEMESTAR-I)

Paper: I (SCA)- SUGARCANE AGRICULTURE

UNIT 1: [15]

Introduction: Origen of Cane, cultivation in India, varieties**,** climatic conditions, sugarcane agro climatic zones in India. Sugarcane pricing and payment, cane as a bio-fuel.

Soil: Types, properties – Visual & morphological properties, analytical properties, fertility & soil problems, sustaining fertility, soil conservation practices,

Planting: Preparatory tillage, planting time, selection of seed cane, methods of planting - Flat, ridges & furrows, trench, IISR 86206, ring, spaced Trans planting & polybag seedling Transplanting method.

Growth of Sugarcane: Germination, development of shoot & root - factors affecting, tillering, growth of leaves, internodes & stem, factors influencing cane growth, formation and storage of sugar in cane.

UNIT 2: [15]

Irrigation: Water requirement, scheduling, method of irrigation – surface, overhead or sprinkler, drip irrigation, water quality, water logging, drainage – side, main & infield drains.

Manuring: Cane nutrition, functions of macro & micro (trace) nutrients, fertilizers – N, P, K, S, Ca & Mg carriers, Mixed or compound fertilizers, biofertlizers, foliar applications, fertigation, organic & green manuring, time & method of application, visual symptoms of nutrient deficiencies and disorders.

Weeds: Common weeds, aquatic weeds, losses due to weeds, methods of weed control – mechanical, manual, chemical (time, method & dosage), integrated weed management, measures to reduce the weeds.

Pests: Leaf eating & sucking insects**,** stalk attacking insects, root attacking insects, soil insects & Non insect species.

Diseases: Major diseases (red rot, smut, pineapple, mosaic, wilt etc), period of occurrence, control measures (chemical & biological), losses due to pests & diseases, plant protection measures.

UNIT 3: [15]

Ripening: Methods of judging ripeness or maturity, factors affecting ripening, accelerating ripening, chemical ripeness.

Harvesting: Manual & mechanical harvesting of cane, transportation of cane, post harvest deterioration of sugarcane – causes, effect & losses, effect of extraneous

Ratooning: Definition, yield & quality, number of ratoons, advantages and disadvantages,

area and productivity, causes for low ratooning, tillering, verities for good ratoons, removal

of compaction, gap filling, fertilizer application, water requirement.

UNIT-04: [15]

a)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 plasma 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,

b)Sugarcane breeding institutes in India.Physiology of sugar cane under normal condition, Physiology of sugar cane under normal saline condition, Rapid screening parameters for salt stress, Agro-technology to improve germination under saline condition, Work on the physiology on various sugar cane clones.

Reference Books:

1. Hartmann and Kester's – Plant propagation – Principles and practices – Hudscan 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. Mehrota
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. Mac Deniels.
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.
15. Elementary Principles of Plant Breeding – H. K. Chaudhari.
16. Trends in Agricultural Insect Pest Management – G. S. Dhaliwal and Ramesh Arora.

M.Sc PART-I (SEMESTAR-I)

Paper: II-(SPC) SUGAR PROCESSING I-CLARIFICATION

UNIT-1 [15]

Introduction of sugar industry &flow chart of sugar manufacturing process. Extraction of juice from cane. Maceration or imbibitions and their scheme Mill sanitation and type of biocides used. Effects of fine bagasillo on juice clarification & its separation. Equipments detail and operation of DSM screen &Rotary screen. Weighing and metering of juice. Equipment detail and operation of Maxwell Boulogne scale and mass flow meter with calibration facility.

.UNIT-.2 [15]

a) 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 DC Hand PHE. Scaling of tube and its removal. Testing of juice heater.

b) Basic chemical required for clarification, their specification. Preparation of milk of lime (MOL) and its equipment details. Storage and pumping of MOL. Separation of grit from MOL. Production of so2 gas by furnace Quantity of air required for burning .Equipment detail and operation of continuous & film type furnace. Roll of phosphate in juice clarification and its use

UNIT-3 [15]

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 &carbonation. New trend in juice clarification.

UNIT-4 [15]

a)Principle of subsidation. Factors affecting the subsidation. Speed of subsidation. surface area and volume of clarifier. Construction and operation of DORR multifeed clarifier.444 Rapi clarifier. Importance of short ration clarifier. Its construction and operation. Preparation of settling chemical and its use. juice and mud removal. Air removal. Losses during shut down and its preservation.

b) Condition for good filtration. Plate and frame type filter press and its working. 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.

Reference books:

Principle of sugar technology vol I P. Honig

Principle of sugar technology vol II P. Honig

Principle of sugar technology vol III P. Honig

Hand book of sugar refinery chung chi chou

Manufacturing and refining og raw sugar Baikow

By product of cane sugar industries Paturau.

] cane sugar hand book R.B.L.Mathur

Cane sugar manufacturing in India D.P.Kukkarn

M.Sc PART-I (SEMESTAR-I)

Paper:III-(SEM) SUGAR ENGINEERING- -MILLING

UNIT 01 Cane handling and feeding [15]

- Cane unloading -Bridge with trolley- having sling bar system-two motion.
- Feeder table-size, slope, chain, breaking strength .power consumption etc
- Cane carrier-horizontal &inclined carrier length. . Width of carrier, Speed of carrier, capacity of carrier, power consumption of carrier. Type of carrier 1) Split cane carrier.2) Rake carrier, 3) Belt carrier.

UNIT 02 Cane preparations [15]

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

UNIT 03 Mills and mill components [15]

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

UNIT 04 Mill drives& Mills setting and Imbibitions [15]

a) Mill drive- Mill drive power requirement, Prime movers for mills, Mill gearing, Mill couplings and tail bars

b)-Mill setting-Roller setting, pressure feeder setting; underfeed roller setting, chute opening, trash plate setting, practical optimization of mill setting.

c) Imbibitions

- Object of imbibitions.
- Type of imbibitions
- Hot and cold water for imbibitions.. Its Merit and demerit
- Imibibition control system.

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 :M axwell

6] standard fabrication practices of cane sugar mill Delden.

7] the energy cane alternative, Alexander

Cane sugar manufacturing in India D.P.Kukkarni

M.Sc PART-I (SEMESTAR-I)

Paper:IV-(CC) CHEMICAL CONTROL

Unit 01 [15]

1.1) Technical definition mill and boiling house.
1.2) Fundamental formula mill and boiling house.

Unit 02 [15]

2.1) Differential method for calculation of Brix %Bagasse, fibre %Bagasse, added water % fibre
2.2) Inferential method for calculation of mixed juice% cane, Bagasse %cane, added water %cane etc.
2.3) Clarification of some concepts like java ratio, E.R.Q.V, B.F.C.W.etc
2.4) Primary Extraction
2,5) Secondary Extraction
2.6) Mill Extraction, reduced mill extraction and whole mill extraction.

Unit 03 [15]

Calculation for run report
3.1) Pol, Brix, Non-sugar balance
3, 2) Clarification efficiency &clarification factory.
3.3) stocking &available sugar.
3.4) Boiling house losses.
3.5) Equivalent standard granulated. (ESG)
3.6) Conversion of raw sugar recovery into white sugar recovery by using ESG formula
3.7) Virtual final molasses purity.
3.8) Operation including &excluding stoppage.

Unit 04 [15]

4.1) Recorded boiling house recovery.
4.2) Theoretical boiling house recovery.
4.3) Ideal boiling house recovery
4.4) Boiling house recovery (ESG)
4.5) Reduced boiling house recovery (GUNDU RAO)
4.6) Overall recovery
4.7) Reduced overall recovery.
4.8-Control parameters and norms for efficiency.

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.

M.SC PART-I (SEMESTAR-II)

Paper-I-(SC) SUGAR CHEMISTRY

UNIT-01: [15]

Carbohydrates – Classification, structure, physical properties, reaction of Glucose and fructose (with organic and inorganic reagents), alkaline, acidic and thermal decomposition.

Sucrose – Structure, formation in plants and nutrition, Physical properties (aqueous, optical electrical), chemical properties (hydrolysis, oxidation, reduction, alkaline, acidic and thermal degradation), sucrose derivatives and uses, enzymic and polymerization products. Polysaccharides – cellulose, starch and dextran.

Crystallization – Mechanism of crystal growth, rate of crystallization (diffusion, viscosity, colloids, crystallographic considerations), crystallography of sucrose.

UNIT-02: [15]

Nonsugars – Organic, inorganic, nitrogenous and non nitrogenous non sugars in cane.

Proteins & Amino acids – Distribution of Nitrogen in cane, Classification & general properties, proteins & amino acids of sugarcane and their behavior during processing – maillard reaction, thermal decomposition, suppression of heat transfer etc.

Coloring Matter – Coloring matter present in sugarcane – chlorophyll, flavonoids, anthocyanins as chlorants, colouring compounds developed in process – caramel, Hexose degradation products, maillard reaction products, Colorimetry.

Colour Removal – Theory of adsorption, adsorption of coloring matter, use of activated carbons. Ion Exchange Resins – theory, regeneration of resins, application in sugar industry.

UNIT-03 [15]

Sucrose – Structure, Physical and Chemical properties, Uses of sucrose; food applications, feedstock for chemical synthesis, fermentation feed stock, pharmaceutical applications, nutrition and health aspects and metabolism of sucrose.

Sugar Analysis – standards and definitions, physical methods of sugar analysis, Polarimetry, Refractive index, colorimetric methods, enzymatic methods, chromatographic methods, NIR, determination of other components; moisture, ash & inorganic constituents, particle size distribution, insoluble matter.

UNIT-04: [15]

Sugar Derivatives & Sugar Alcohols – Ethers: – Triethyl ethers, methyl ethers, other alkyl ethers, silyl ethers, cyclic acetals. Esters: - Acetates, benzoates, pivalates, fatty acid esters, other carboxylic esters, sulphonate esters, deoxyhalogen derivatives, anhydrides & epoxides, nitrogen containing compounds, sulphur containing compounds, oxidation compounds fromenzymic isomerization, polymeric intermediates.

Sugar Alcohols: - Occurrence, Physical & Chemical properties; anhydrization, esterification ,etherification, acetal formation; oxidation, reduction, metal complexes, isomerization, analysis,manufacture of sorbital, mannitol & xylitol.

Reference books:

Organic chemistry :Hendrick,Cram,Hammond.

Organic chemistry :Morrison&Boyd

Organic chemistry :Finer I.L

Organic chemistry :Pine

Advance Organic chemistry :Sachin kumar Ghosh.

Advance Organic chemistry :B.S.Bahl& Arun Bhai

Principle of sugar technology. P.Honig

M.SC PART-I (SEMESTAR-II)

Paper:II-(SP E) - SUGAR PROCESSING-II-EVAPORATION

UNIT-1 **[15]**

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

UNIT-2 **[15]**

Construction of Robert type evaporator. Entrainment and entrainment separator. Different types of evaporator body . Condenser and type of condenser. Quantity of water required for condention. Vapor velocity and vapor piping.

UNIT -3 **[15]**

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

UNIT-4 **[15]**

a)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.

b)Treatment of syrup. Construction and working of syrup sulphitor. Scale formation and removal

Reference Books:

1 Principle of sugar technology vol I P. Honig

2 Principle of sugar technology vol II P. Honig
3 Principle of sugar technology vol III P. Honig
4 Hand book of sugar refinery chung chi chou
1. Manufacturing and refining og raw sugar Baikow
2. By product of cane sugar industries Paturau.
3.] cane sugar hand book R.B.L.Mathur
4. Cane sugar manufacturing in India D.P.Kukkarn
5. Hand book of cane sugar E.Hugot
6. Cane sugar engineering . Peter Rain

M.SC PART-I (SEMESTAR-II)

Paper: III-(SESP) SUGAR ENGINEERING- I –STEAM &POWER GENERATION.

Unit 01

:**Steam Generation: (Boiler)** [15]

- Properties of steam,
- Fuels (Bagasse) , characteristics of Bagasse, combustion Bagasse,
- Furnaces (Spreader Stoker & Travelling Grate),
- Boiler, Super heater, Economizer, Air preheated,
- Boiler accessories –feed water tank I.D.&F.Dfans Chimney ,electrostatic participator etc

Unit 02

Boiler Instrumentation & Control [15]

- Various flow meter to measured flow 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

Uni03

Boiler water treatment

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

Unit 04

Power generation and Alternator [15]

a)Power generation-

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

b)Alternator –

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

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 :M axwell

6] standard fabrication practices of cane sugar mill Delden.

7] the energy cane alternative, Alexander

Cane sugar manufacturing in India D.P.Kukkarni

M.Sc PART-I (SEMESTAR-II)

Paper: IV-(EDD) EQUIPMENTS DESIGN AND DRAWING.

UNIT 01 [15]

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.

b) Juice Sulphitor

- Factors used to design continuous juice sulphitor or reaction tank.
- Lime proportioning device (lime dosing**)**
- So2 gas distribution (So2 gas dosing)
- Mechanical stirrer for mixing of reagent
- Design of tank with respect of diameter
- Automation for ph control
- Construction of continuous juice sulphitor

UNIT 02 [15]

a) Sulphur Burners/ Furnace

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

b) Juice Clarifier

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

Unit03

a) evaporator **[15]**

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

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.

UNIT 04
[15]
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

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

c) Centrifugals

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

d) Hopper & Grader

- Drying &cooling of sugar
- Grading of sugar

Syllabus of Practical Courses - M.Sc. Sugar Technology

SEMESTER I

1) SUGAR CANE AGRICULTURE

Study of external morphology of sugarcane plant.

1) Study of internal morphology of sugarcane plant- T. S. of root,

2) Study of internal morphology of sugarcane plant- T. S. of stem

3) Study of internal morphology of sugarcane plant- T. S. of leaf.

4) Determination of soil pH (Any suitable method).

5) Study of soil texture

. 6) Determination of humus content (fertility) of the soil sample

. 7) Study of deficiency symptoms of macronutrients (N, P, K) in sugarcane plant. (Demonstration) 8) Study of sugarcane diseases- red rot, whip smut, leaf scald.

9) Study of sugarcane diseases red strips, mosaic and grassy shoot.

10) Study of sugarcane pests- termites, shoot borer, white flies and armyworms

. 11) 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) & Sulphited Juice (Bromo thymol 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 Hydrometer and hand refracto meter.
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
    - ✓ double polarization method(Jackson &Gilis)
    - ✓ Fehling's method.
11. To determine reducing sugar of juice by
    - ✓ Eyon and lane method
    - ✓ Luffs method
12. To determine sucrose of final molasses by
    - ✓ double polarization method(Jackson &Gilis)
    - ✓ Fehling's method.
13. To determine reducing sugar of final molasses by
    - ✓ Eyon and lane method
    - ✓ Luffs 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
- ➢ Moisture(loss on drying)
- ➢ Pol % by polarmeter
- ➢ Sucrose by Jackson &Gillis
- ➢ Reducing sugar by Ofner method
- ➢ Ash (sulphated &conductivity)
- ➢ Grading of sugar in term of ISS

2] Analysis of raw sugar for
- ➢ Moisture(loss on drying)
- ➢ Pol % by polarmeter
- ➢ Sucrose by Jackson &Gillis
- ➢ Reducing sugar by Ofner method
- ➢ Ash (sulphated &conductivity)
- ➢ Color in solution
- ➢ Grain size by test sieve.

3) Analysis of Jaggery for
- ➢ Moisture(loss on drying)
- ➢ Pol % by polarmeter
- ➢ Reducing sugar
- ➢ Net Rendenment

4] Determination of melting point of sucrose and boiling point of different concentration sugar solutions

5] The Determination of Insoluble Matter in White Sugar

6] The Determination of the Particle Size Distribution of White Sugar by sieve method

7] Analysis of raw and white sugar for color by MOPS method.

8] to determine sulphur dioxide (so2)in sugar.

9) to determine flock test by Coca cola method.

2) SUGARTECHNOLOGY –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.

5 To determine mud volume of juice by heating, liming & addition of flocculants

5 To determine optimum PH of shock liming for good clarification.
6 To determine So2 contend in syrup.

9) To det ermine size of crystal in slurry/seed/massecuite. By microscope.

10) To determine crystal% massecuite by purity and lab centrifugal machine.

11) To determine phosphate content of juice by

- ✓ Ammonium molybdate method.
- ✓ Uranium acetate method. .

12) To determine CaO content of juice by

- ✓ EDTA method
- ✓ Ammonium oxalate method.

13) To determine sulpheted Ash of juice,

14) analysis of boiler water for

- ✓ TDS
- ✓ Hardness
- ✓ Alkalinity.
- ✓ Dissolve oxygen.
- ✓ Chlorine.

15) Analysis of effluent for

- ✓ Total solids
- ✓ Total suspended solids
- ✓ Total dissolved solids
- ✓ Bio chemical oxygen demand
- ✓ Chemical oxygen demand.