

**MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION,
MUMBAI-51**

1	Name of Syllabus	C. C. IN PAN BOILING (w.e.f. 2018-19) (303207)																																																														
2	Max.Nos of Student	25 Students																																																														
3	Duration	1 year																																																														
4	Type	Part Time																																																														
5	No. Of Days / Week	6 Days																																																														
6	No. Of Hours /Days	7 hrs.																																																														
7	Space Required	1) Laboratory = 200 sqfeet 2) Class Room = 200 sqfeet TOTAL = 400 sqfeet																																																														
8	Entry Qualification	S.S.C.																																																														
9	Objective Of Syllabus/ introduction	COURSE OVERVIEW: This Certificate Course in Sugar Pan Man is primarily designed and developed in order to cater to the needs of Middle Supervisory cadres of Manufacturing department of the Industry. So as to provide “Skilled Technical Manpower” it is very essential to upgrade technological aspect regularly. So the course content is designed in such a way that it will expose to related fields in a very short duration and will help in creating promotional career in the Industry.																																																														
10	Employment Opportunity	Student can get employment in Sugar Industry as a Pan In charge, Assistant Pan Man, Pan Man etc.																																																														
11	Teacher’s Qualification	Degree In Sugar Technology / Engineering																																																														
12	Training System	Training System Per Week <table><tr><td>Theory</td><td>Practical</td><td>Total</td></tr><tr><td>6 hrs</td><td>18 hrs</td><td>24 hrs</td></tr></table>							Theory	Practical	Total	6 hrs	18 hrs	24 hrs																																																		
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13	Exam. System	<table><tr><td>Sr. No</td><td>Paper Code</td><td>Name of Subject</td><td>TH/PR</td><td>Hours</td><td>Max. Marks</td><td>Mini. Marks</td></tr><tr><td>1</td><td>30320711</td><td>ELEMENT OF SUGAR MANUFACTURING</td><td>TH-I</td><td>3 hrs.</td><td>100</td><td>35</td></tr><tr><td>2</td><td>30320712</td><td>THEORY OF PAN BOILING</td><td>TH-II</td><td>3 hrs.</td><td>100</td><td>35</td></tr><tr><td>3</td><td>30320713</td><td>PAN CONTROL OPERATIONS</td><td>TH-III</td><td>3 hrs</td><td>100</td><td>35</td></tr><tr><td>4</td><td>30320721</td><td>COMPUTER APPLICATION</td><td>PR-I</td><td>3 hrs</td><td>100</td><td>50</td></tr><tr><td>5</td><td>30320722</td><td>PAN BOILING</td><td>PR-II</td><td>3 hrs.</td><td>100</td><td>50</td></tr><tr><td>6</td><td>30320723</td><td>INPLANT TRAINING</td><td>PR-III</td><td>3 hrs.</td><td>100</td><td>50</td></tr><tr><td></td><td></td><td>Total</td><td></td><td></td><td>600</td><td>255</td></tr></table>							Sr. No	Paper Code	Name of Subject	TH/PR	Hours	Max. Marks	Mini. Marks	1	30320711	ELEMENT OF SUGAR MANUFACTURING	TH-I	3 hrs.	100	35	2	30320712	THEORY OF PAN BOILING	TH-II	3 hrs.	100	35	3	30320713	PAN CONTROL OPERATIONS	TH-III	3 hrs	100	35	4	30320721	COMPUTER APPLICATION	PR-I	3 hrs	100	50	5	30320722	PAN BOILING	PR-II	3 hrs.	100	50	6	30320723	INPLANT TRAINING	PR-III	3 hrs.	100	50			Total			600	255
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THEORY – I - ELEMENTS OF SUGAR MANUFACTURING

S.N	TOPICS	SUB TOPICS
1	SUGAR CHEMISTRY	Biosynthesis of sugar in sugar cane plant, Chemical Formula for Sucrose, Composition of Cane Juice, Sugars and Non-sugars in juice, Reducing Sugar Working Principle of Polarimeter,
	SUGAR MANUFACTURING	
2		General introduction to Process Sugar Manufacture from sugar cane, General description of the process: Extraction of juice from Cane, Purification of Juice, Evaporation, Crystallization, Centrifugation, Packing.
	CLARIFICATION OF JUICE	
3		Effect of Heat, Acid and Alkali treatment on Cane Juice, Various Methods of Clarification, Chemical Reaction involved in Clarification of Juice, Raw Sugar, Refined Sugar, Khandasari Sugar, Jaggery, etc,(Process Flow Chart Only)
	CHEMICAL CONTROL	
4		Basic definitions of Brix, Pol, Purity of various intermediate products, Boiling house Recovery, ICUMSA Color Index and Grades (L, S, M) of Sugar, By products of Sugar Industry, Various Sources of waste water in Sugar Industry, Effluent Treatment (Flow Chart Only)
	EQUIPMENTS	
5		Chronological order of various major Unit Operations involved in the process of sugar manufacture, Principles and uses of major equipments, Constructional aspects of the major equipments involved in Sugar Manufacture Process, Difficulties encountered during operation of these equipments.
	MAINTENANCE	
6		Importance of effective maintenance, Preventive Maintenance, Factors affecting Off-season and seasonal maintenance in Sugar Industry, Guide lines for maintenance of Boiling house Equipment, Cleaning day, Cleaning day schedule, Closing the process on cleaning day, Break down and stoppages

THEORY – II - THEORY OF PAN BOILING

SN	TOPICS SUB TOPICS
1	CRYSTALLISATION Principle involved in pan boiling, Various zones of Super Saturation, Factors affecting rate of crystallization, Boiling point elevation, Crystallization in motion, Crystallization by evaporation and cooling, Importance of good clarification and their effect on Crystallization.
2	TYPES OF PAN AND ACCESSORIES Calindria pan, Low Head Pan, Continuous pan, Pan controlling instruments, Constructional and Working aspects of vacuum pan, Jet Condenser.
3	CIRCULATION Natural and Mechanical circulation, Their utility and importance, Effect of temperature and vacuum, Open Pan Boiling & Pan Boiling under vacuum.
4	BOILING SCHEME Two boiling, Three boiling and four boiling Scheme, Effect of juice purities, molasses purities on Sugar Boiling and quality of sugar, Graining Methods: Waiting method, Shock seeding method, True seeding method (Slurry method)
5	PAN FOOTINGS AND CHEMICALS Selection of footing or seed for high grade and intermediate grade strikes, preparation of seed, Tightening of massecuite, Various chemicals used in pan boiling.
6	CAPACITY AND CALCULATIONS Capacity of Pan, Crystallizer, Centrifugal machine etc, Pan station calculations & adjustment.

THEORY – III - PAN CONTROL OPERATIONS

SN	TOPICS SUB TOPICS
1	SUGAR PAN CONTROL Duties of pan-man, Boiling house position, reading and estimation of material like molasses, syrup, melt massecuite etc. Boiling scheme adjustments suitable to boiling house position, co-ordinations of steam generation and consumption.
2	SUGAR PAN OPERATIONS Operational details and precautionary measures of starting a pan, seed enlarging, molasses and syrup charging, pan cuttings, Material transferring, Pan cleaning and water boiling, cleaning day schedules, steps for finishing the process economically.
3	CRYSTALLISER Constructional aspects of Crystallizer, Crystallizer operation, filling, discharging, massecuite, conditioning, treatment, gravity flow, pump flow, conditioning of massecuite in pugmills.
4	CURING PERFORMANCE Constructional aspects of centrifugals, Magama making, single curing, double curing magma melting, Operation of centrifugal machines, curing cycles super heated wash, Separating light and heavy molasses.
5	PURGINGS Low grade purging, magma seed, dry seed, Wet seed, influence on finished sugar crystal, bold grain boiling, inter relation of size of crystal and boiling Scheme

PRACTICAL – I - COMPUTER APPLICATION

S N	TOPICS
1	COMPUTER: What is Computer?, Working of Computer System, Types of Computer,
2	Hardware and Software Operating System Software, BASIC UNITS OF COMPUTER:
3	Input units, Central Processing Unit, Output Units, Storage Unit: Floppy disk, Hard disk, Optical disk(CD, DVD), Pen Drive
4	COMPUTER SOFTWARE Operating System Software: Windows: Menus, Tool bars, Help etc.General Application Software: MS Office: MS- Word, Power Point, MS Excel
5	COMPUTER APPLICATION Networking:
6	Educational Management, Teaching and Learning Process, Communication and Connectivity, Online services: Online Education, Sharing of Learning Resources. Internet Services: E-mail, Voice / Messaging System, Video Conferencing, Entertainment, Surfing or Navigating the World wide web, Searching information.

PRACTICAL

AIM: To improve I. T. skills of the students and accommodate various learning styles and to allow various levels and abilities of the learners. The practical would be conducted in the focus of following I T skills improvement.

1. Use of the mouse, Key board skills, Using printer
2. Word processing skills: Editing skills eg. Cut & Paste, Highlighting
3. Making Power Point Presentation
4. Using electronic Communication – E-mail
5. Using the Intranet / Internet
- 6.

PRACTICAL – II - PAN BOILING

Practical Examination on the theoretical course prescribed in Paper I, II and III

During weekly visit to the Nearby Sugar Industry the practical of this subject are to be conducted and the students have to study various aspects related to the Paper I, II and III.

At the end of term student have to submit

- A Journal consisting details of the Methods of analysis / Practical Listed below.
- Journal consisting details (constructional, working ,operational aspects) of Major equipment studied along with guidelines of maintenance of the same.
- Section wise well labeled Diagram/Drawings/ Sketches of equipments.

PART-I

1. To determine the Normality & Strength of Acid and Base
2. To determine pH, Hardness of water
3. To determine pH value of Cane Juices & various Sugar solutions.
4. To determine Brix of the Sugar Solution.
5. To Determine Pol & Purity of Sugar Solutions.
6. To Determine Brix, Pol, Purity of syrup.
7. To Determine Brix, Pol, Purity of Different massecuite.
8. To Determine Brix, Pol, Purity of different intermediate Molasses
9. To Determine Brix, Pol, Purity of Final Molasses
10. To Determine Brix, Pol, Purity of Jaggery.

PART-II

11. To perform Sugar test of water
12. To Study method of slurry preparation by using ball mill
13. To Determine CaO content in Lime
14. To Determine Pol % Sugar
15. To Determine Moisture % Sugar
16. To Determine Ash % Sugar
17. To Determine Grade & Colour of Sugar
18. To Determine Reducing Sugar in Final Molasses
19. To Determine Ash % Final Molasses

PART-III

A rough list of major equipment to Study is as under:

1. Mill House Equipments: Cane Preparatory Devices, Mill Tandem, Boiler, etc
2. Boiling House Equipments: Juice Weighing Scale, Reaction Tank, Juice Heaters
Lime preparation device, Sulphur Furnace, Air Compressor, Clarifier, Rotary Drum Vacuum Filter, Evaporator, Vapor bleeding arrangement, Pan, Condenser.
3. Crystallizers: Water cooled, Air Cooled, Vacuum, Vertical Crystallizer.
4. Centrifugals: Batch type and continuous machines
5. Sugar hopper, elevator and grader.
6. Cold and Hot water distribution.
7. Various types of valves and pumps used in Sugar Industry.

PRACTICAL – III - INPLANT TRAINING

* TO BE ASSESSED BY EXTERNAL EXAMINER / EXPERT FROM NEARBY SUGAR INDUSTRY

ENTIRE PRACTICAL WORK IS TO BE DONE DURING IN PLANT TRAINING AT FACTORY SITE UNDER THE SUPERVISION OF FACULTY MEMBERS.

In-plant Training in sugar industry is of prime importance and compulsory with respect to develop the understanding of the Subject based knowledge given in the classroom in the context of its application at workplaces.

The Students shall undergo Training Program prepared by Department / Institute in order to gain firsthand experience and confidence; which make possible the students to use and apply the knowledge and skills to solve practical problems in the fields. During In-plant Training, student should work, observe & study the Working and Operation of the various equipments / units. The student is expected to go through various methods of operations and work on each station in sugar factory.

Objectives - The student will be able to

- Know entire process of sugar manufacture with logical sequence.
- Use various techniques to handle and control the Sugar boiling process effectively, Economically & independently.
- Work at Pan Station in the Sugar Plant independently
- Develop understanding of Pan Station activities in order to assist the Head of the Pan Section / Shift Chemist after completing this Course.
- Develop special skills (related to Psychomotor & Affective domain) and abilities like interpersonal skills, Communication Skills, Attitudes, Values etc.

Instructional strategies:

The students shall undergo In-plant Training as per the guide lines in the Questionnaire provided by the Department in the following Areas:

Such as: Plant Layout, Plant Maintenance (Scheduled and While Operating), House Keening and Safety, Material Handling, Milling and Boiling House Operation, Pan Control Operation and Curing Performance and Quality Control, Pan Station Calculation and Adjustment, Planning of cleaning day schedule economically, Inventory required at Pan Station and its Control, Improvement techniques in Sugar Boiling, Sources of waste effluent and their treatment, Automation at Pan Station.

INPLANT TRAINING SCHEDULE

Sr No	Sections / Units
01	<ul style="list-style-type: none"> To observe & study the Layout of Sugar Plant and Process Flow. Laboratory Analysis: To observe & study the Brix, Pol and Purity of various intermediate products (required at Pan Station) in sugar manufactures.
02	<ul style="list-style-type: none"> To observe & study the Working and Operation of the equipments involved in Mill House and Boiling House. To observe, study and workout the Steam Requirement and Distribution at Pan Station.
03	<ul style="list-style-type: none"> To study Layout of pan station. To work, observe & study the Working and Operation of the equipments involved in Crystallization: Types of pans, Jet Condensers, Types of Crystallizers, Vacuum Crystallizers, Vertical Crystallizer, Arrangement and Capacity. Sugar boiling process in detail with boiling scheme adopted, Crystallization system, Molasses conditioning, Method adopted for graining, Various graining Techniques for High grade and Low grade massecuite , Molasses conditioning, Molasses Tanks, Cooling and reheating system for low Grade massecuites.
04	<ul style="list-style-type: none"> To work, observe & study the Working and Operation of the equipments involved in Centrifugation, Drying, Graddation of Sugar etc
05	<ul style="list-style-type: none"> To observe & study the Break down and Stoppages due to: No cane, House Jamming, Break-down of Machinery, Difficulties encountered during operation of the various equipments. To observe & study the Maintenance Program: Preventive, Periodical, During Crushing Season and Off-Season To observe & study the Cleaning day schedule and finishing the process economically. To study By-products of sugar: Their Uses and Compositions Sources of waste effluent water in Sugar Plant, Treatment Plant & Methods, Pollution control measures.
06	<ul style="list-style-type: none"> Data collection and Report Writing and Miscellaneous Work: From the daily Diary complying the details as per Questionnaire set provided by the parent department during placement for Inplant Training and submission of Project Report accordingly.

Note: Student has to undergo for training in Industry and work as per the Instructions of Chief Chemist / Shift Chemist / Competent authority of Manufacturing Section / Chief Engineer / Managing Director.

A) List of Reference Books

Title of the Book	Name of the Author
1. Can Sugar Hand Book	Spencer & Meade
2. Principles of Sugar Technology(Vol – I, II & III)	P. Honig
3. Introduction to Cane Sugar Technology	Jenkins
4. Principles of Cane Sugar Manufacturer	J. G. Davies
5. Hand Book of Sugar Manufacturing	RBL Mathur
6. Cane Sugar Processing Principles & Process	S. V. Karmarkar
7. Systems of Technical Control for Sugar Factories	N. C. Varma
8. Computer Application:	
a. (Any Elementary Text Book / “ Self Tutor”	
b. CD developed by MKCL for MS-CIT Examination	
