SHIVAJI UNIVERSITY, KOLHAPUR

New Syllabus

for

Master of Science (Sugar Technology)

Part- II (Semester-III and Semester-IV)

Syllabus to be approved from June 2017 onwards

Shivaji University, Kolhapur

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M. Sc., PART-II (SEMESTAR-III)
Paper: IX- (ECC) EQUIPMENTS CAPACITY CALCULATION

Unit 01 **[15]**

a) Capacity of weighing scale and reaction tank.

- Capacity of juice and imbibition's water weighing scale,
- Capacity of raw juice and imbibition's water pumps,
- Capacity of reaction tank, calculation of retention time of juice in reaction tank. Calculation for SO_2 gas distribution system

b) Capacity of equipment for process chemical

- Capacity of phosphoric acid and dosing equipment.
- Capacity of lime preparation equipments and lime pumps.
- Capacity of sulphur burner and air compressor.

Unit 02 [15]

a) Capacity of juice heater

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

b) Capacity of clarifier& vacuum filter

- Juice retention time in different type of clarifier
- Capacity of clarifier
- Capacity of clear juice pump, capacity of mud pump. Capacity of flash tank.
- Capacity of rotary vacuum filter.
- Capacity of syrup sulphitor and syrup pumps.

Unit 03 **[15]**

a) Capacity of evaporator

- Co-efficient of heat transmit ion,
- Quantity of water evaporated,
- Heating surface of evaporator station.
- Calculation of individual Brix
- Calculation of vapor piping.

- Steam requirement without vapor bleeding, steam requirement with vapor bleeding to juice heater and pan.

b) Vacuum pan

- Pan capacity by massecuite % cane method.
- Calculation of heating surface and number of tubes.
- Pan capacity by solid balance method.
- Calculation of vapor pipe & condensate pipe size.
- Sizing of condenser , water requirement for condenser, capacity of injection pump.

Unit 04 **[15]**

a) Centrifugals

- Capacity of cooling crystallizers, quantity of water required for cooling,
- Capacity of centrifugals, capacity of runoff pump.
- Capacity of melter and melt pump
- Capacity of final molasses weighing scale.
- Capacity of superheated wash water system.

b) Finishing operation.

- Capacity of hopper, elevator and grader.
- Capacity of hot and cold air blower.
- Capacity of sugar silo.
- Capacity of molasses storage tank,
- Capacity of sugar storage godown

Reference Books:

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

M. Sc., PART-II (SEMESTAR-III)
Paper: X -(SPC) SUGAR PROCESSING - CRYSTALLIZATION

Unit 01 **[12]**

- Theory of crystallization & its zones
- Granting & graining methods
- Principals & practices in graining process.

Unit 02 **[12]**

- Mechanism of pan boiling.
- Different massecuite boiling scheme
- Principles and practices in pan boiling.

Unit 03 **[12]**

- Construction of pan
- Types of pan
- Pan control & instrumentation.

Unit 04 **[12]**

- Cobenze's method for purity control
- Calculations of massecuite % cane & molasses % cane by solid balance
- Determination of crystal % massecuite.
- Determination of crystal size, volume and surface area
- Determination of steam requirement for massecuite boiling.

Unit 05 **[12]**

- 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 factor affecting exhaustion

Reference Books:

1. Principle of sugar technology, Vol I, P. Honig
2. Principle of sugar technology, Vol II, P. Honig
3. Principle of sugar technology, Vol III, P. Honig
4. Hand book of sugar refinery, Chung Chi Chou
5. Manufacturing and refining of raw sugar, Baikow
6. By product of cane sugar industries, Paturau
7. Cane sugar hand book, R. B. L. Mathur
8. Cane sugar manufacturing in India, D. P. Kulkarni
9. Hand book of cane sugar, E. Hugot
10. Cane sugar engineering, Peter Rain

M. Sc., PART-II (SEMESTAR-III)
Paper: XI (CEH & MT) CHEMICAL ENGINEERING (Heat & Momentum Transfer)

Unit 01 Heat transfer [15]

1.1 Conduction- Mechanism of heat transfer by conduction in solids, Fourier's low of heat transfer, Thermal conductivity, and heat loss in conduction. Thermal insulation and optimum thickness for insulation.

1.2 Convection- Heat transfer by convection, forced and natural convection, individual and overall heat transfer coefficient. Fouling factor, overall resistance. Effect of drop wise and film wise condensation, Effect of non- condensable gases.

1.3 Radiation -heat transfer by radiation. Kirchhoff's law, Stefan-Boltzmann law

Unit 02 Heat transfer equipment [15]

2.1 Heater- multipass shell and tube type heat exchanger-shell, tubes, tube pitch ligaments' (clearance), tube passes, Baffles.

2.2 Condenser-types of condenser co-current &counter current.

2.3 Derivation of overall heat transfer coefficient from hot fluid to cold fluid through metal wall

Unit 03 Fluid transfer [15]

3.1 Fluid statics- Concept of momentum transfer, Nature of fluid and pressure concept, variation of pressure with height- hydrostatic equilibrium. Barometric equation, measurement of fluid pressure manometer.

3.2 Fluid flow –types of fluid's , viscosity of gases and liquids. Types of flow – laminar & turbulent, Reynolds number. Basic equation of fluid flow, Average velocity, and mass velocity, conductivity equation, flow of incompressible fluids. Laminar flow through circular circuit, turbulent flow through pipes, fraction factor

Unit 04 Fluid transfer equipments: [15]

Pumps – positive displacement and centrifugal pumps. Fans, compressor and blower. Metering of fluids - Pipes, Fitting and valves, measurement of liquid and gas flow rates by orifice meter, venture meter, rot meter and Pilot tube.

Reference Books:

1. Unit operations & Unit Processes, C. M. Narayanan, B. C. Bhattacharya.
2. Unit operations I & II (Heat & Mass Transfer), K. A. Gavhane
3. Chemical Engineering (Heat Transfer & fluid flow), J. M. Couslson
4. Unit operations & chemical engineering, P. Chattopadhyay.

ELECTIVE SUBJECTS
M. Sc., PART-II (SEMESTAR-III)
Paper: XII-ALCOHOL TECHNOLOGY

Unit 01 Cane molasses. [15]

a) Composition of molasses, gradation of molasses, storage of molasses, factors responsible for reducing the ratio (F/NF) of molasses, other use of molasses.
b) Definition of-
   - ✓ Molasses, Total reducing sugar, Fermentable/Unfermentable sugar, Residual sugar.
   - ✓ Wort, Brix, Specific gravity, Distillation, Industrial alcohol, Proof sprit, Strength of sprit, Reflux, Vaporization.
   - ✓ Saccharification,Scaling, Scrubber, Starch -sucrose, Rectification, Gelatinization, liquefaction, Reboiler

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

Unit 02 [15]

a) Defination & type of fermentor
   - ✓ Traditional batch, fed batch & continous fermentation
   - ✓ Difference between batch & continous fermentation.
   - ✓ Alcohol production from sweet sorghum
   - ✓ Alcohol production from cane syrup

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

Unit 03 [15]

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

b) Distillation equipments

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

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Unit 04 [15]

a) Effluent treatment system in Distillery,
- ✓ Quality of effluent, IS specification of effluent.
- ✓ Biological treatments.
- ✓ Aerobic treatments,
- ✓ Anaerobic treatments

b) Manufacturing of Methane gas % composting.
- ✓ Raw material requirement of biogas plant.
- ✓ Design & capacity of biogas plant
- ✓ Moisture free methane generation.
- ✓ Types of composting & their production
- ✓ Factors affecting composting process.
- ✓ Economics consideration in composting process.

Reference books:

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

OR
M. Sc. PART-II (SEMESTAR- III)
Paper: XII-BIOCHEMICAL ENGINERRING

Unit 01 **[15]**
Introduction:

- Bioprocess engineering and technology. An introduction to basic biological science
- Microbiology: Structure of cells: Prokaryotes & Eukaryotes. Classification of microorganism. Taxonomy, control of microorganism– physical & chemical methods.
- Biological functions of lipids, sugars, polysaccharides, amino acids, vitamins, biopolymers, Nucleic acids: RNA, DNA and their derivatives.

Unit 02 **[15]**

- Enzymes and proteins**:** Detailed structure of protein and enzymes. Functions. Methods of production and purification of enzymes. Nomenclature and classification of enzymes. Kinetics & mechanism of enzymes action.
- Kinetics of enzyme action: reversible enzyme, two substrate, multi-complexes enzyme kinetics. Experimental determination of rate parameters: Batch & continuous flow experiments, Batch Kinetics.
- Enzymes Inhibition**:** effect of inhibitors, temperature & pH on the rates enzyme catalyzed reactions. Determination of kinetic parameters for various types of inhibitions. Dixon method. Enzyme immobilization: Uses, methods of immobilization .

Unit 03 **[15]**
Fermentation Technology

- Ideal reactors: A review of batch and continuous flow reactors for bio kinetic measurements. Microbiological reactors: operation & maintenance of typical aseptic aerobic fermentation processes.
- Formulation of medium source and nutrients. Introduction to sterilization of bioprocess equipment.
- Growth kinetics of microorganism**:** Transient growth kinetics (different phase of batch cultivation). Quantification of growth kinetic, continuous culture, optimum dilution rate and washout condition in ideal chemostat. Introduction to fed batch reactors.

Unit 04 [15]

- Downstream processing**:** strategies and steps involved in product purification.
- Methods of cell disruption, filtration, centrifugation sedimentation
- Types of chromatography technique
- Freeze drying /lyophilisation & membrane separation processes.

OR

M. Sc., PART-II (SEMESTAR-III)

Paper: XII-ELECTRONIC & INSTRUMENTS ENGINEERING.

Unit 01 **[15]**

- Basic Electronics: Circuit elements in series & parallel. Semiconductor Devices – Diode as Rectifier, Zener Diode as Voltage Regulator, Transistor as Amplifier. Field Effect Transistor – Jeet & Mosfet. Thirstier – Silicone Controlled Rectifier.
- Number Systems: Decimal & binary systems, binary addition, subtraction, multiplication, division, use of complement.
- Boolean Algebra: Basic laws of Boolean algebra, De-Morgan's theorems, minimization techniques.
- Logic Gates: OR, AND, NOT, NOR, NAND, EXOR gates.
- Arithmetic Logic Units: Half adder, full adder, parallel binary adder and subtractor. Introduction to basic configuration of computer.

Unit 02 **[15]**

- Instrumentation: Introduction, important terms associated with instruments such as range, span, accuracy, error and sensitivity.
- Flow measurement: Types of flow, flow transducers - orifice plate, pitot tube, venturimeter. Description of rotameter, magnetic flow meter, ultrasonic flow meter etc.
- Temperature measurement- Introduction to filled system thermometers, Expansion thermometers, thermocouples, RTD's, Thermostats and pyrometers.

Unit 03 **[15]**

- Pressure measurement - Various units and their conversion, manometers, Bourdon tube, diaphragm, bellows, capsule, strain gauges for pressure measurement.
- Level measurement: Direct methods - float methods, magnetic level indicator, magnetic level switches, indirect method - hydrostatic method, radiation method, ultrasonic method and capacitance method.
- pH and conductivity measurement**:** Introduction, different types of sensors, pH meter and conductivity meter.

Unit 04 **[15]**

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

Syllabus of Practical Courses - M. Sc. Sugar Technology (Semester-III)

1. Sugar technology-III (Analysis of sugar as per ICUMSA Method):

1. The Determination of sugar solution colour at pH 7.0 by the MOPS Method –Official Method GS 9/1/2/3 – 8 (2005), ICUMSA Method Book.
2. The determination of white sugar solution colour at pH 7.0 method GS 2/3 – 9 (2002)– ICUMSA Method Book.
3. The determination of white sugar solution colour - Official Method GS 2/3 – 10(2002), ICUMSA Method Book.
4. The determination of white sugar solution colour - Official, Method GS 2/3 – 10 (2003), ICUMSA Method Book.
5. The determination of Conductivity ash in sugar, method GS 2/3 – 17(2002) –ICUMSA Method Book.
6. The determination of moisture in sugar method GS 2/1/3–15(2002) – ICUMSA Method Book.
7. The determination of reducing sugar in sugar method GS 2/3/9 – 5(2007) ICUMSA Method Book.
8. The Determination of Insoluble Matter in White Sugar by Membrane Filtration Method GS 2/3/9 – 19 (2007) ICUMSA Method Book.
9. Mesophilic Bacteria in Sugar ICUMSA method GS2/3-41 (1998)
10. Yeasts and Moulds in Sugar ICUMSA method GS2/3-47 (1998)

2. Sugar technology-IV (Analysis of process chemicals)

1. Analysis of sulphur
   a) Moisture % sulphur
   b) Ash % sulphur
   a) Purity of sulphur
2. Determination of Cao & grit % in given sample of lime by sucrose method.
3. Determination of density & phosphate content in phosphoric acid.
4. Determination of SO_2 in hydrogen peroxide.
5. Mill sanitation –
   a) Dithio-Carbamate base
   b) Quaternary ammonium compound.
6. Determine total alkalinity of caustic soda.
7. Determine total acidity of HCl (Hydrochloric Acid)
8. Determine available chlorine & moisture content in bleaching powder.
9. Determine total fatty material & specific gravity in T.R.O. (Turkey Red Oil)
10. Determine total alkalinity in washing soda (Na_2CO_3).
11. Determine formaldehyde (formaline) content sodium sulphide method.

M. Sc., PART-II (SEMESTAR-IV)
Paper: XIII (SP-F) SUGAR PROCESSING –FINISHING

Unit 01 [15]

1.1 Centrifugal theories
1.2 Centrifugal forces.
1.3 Mean equivalent radius
1.4 Gravity factory.
1.5 Time cycle
1.6 Capacity of basket.
1.7 Moment of inertia
1.8 Powered required.

Unit 02 [15]

2.1 Constructions of batch machine, types of drive and control
2.2 Constructions of continuous machine types of drive and control

Unit 03 [15]

3.1 Centrifugal operations
- ✓ Screen washing
- ✓ Sugar washing
- ✓ Massecuite charging
- ✓ Separation of light and heavy molasses.
- ✓ Spinning and drying
- ✓ Discharging

3.2 Super heated wash water system
3.3 Sugar melter capacity, control system for temperature &Brix
3.4 Pug mill, magma &run off tank.
3.5 Molasses weighing scale construction, operation

Unit 04 [15]

4.1 Theory of drying &cooling
4.2 Drying and cooling of sugar on hopper, fluidized bed drier, Rotary drier
4.3 Grading of sugar, packing of sugar.
4.4 Stitching and weighing of sugar
4.5 Keeping quality of sugar, storage of sugar
4.6 Specification of sugar as per IS standard.
4,7 Constriction of godown & storage of molasses
4.8 Sugar handling &transporting system.

Reference Books:

1. Principle of sugar technology, Vol I, P. Honig
2. Principle of sugar technology, Vol II, P. Honig
3. Principle of sugar technology, Vol III, P. Honig
4. Hand book of sugar refinery, Chung Chi Chou

5. Manufacturing and refining of raw sugar, Baikow
6. By product of cane sugar industries, Paturau
7. Cane sugar hand book, R. B. L. Mathur
8. Cane sugar manufacturing in India, D. P. Kulkarni
9. Hand book of cane sugar, E. Hugot
10. Cane sugar engineering, Peter Rain

M. Sc. PART-II (SEMESTAR-IV)
Paper: XIV (ASM) ALLID SUGAR MANUFACTURING

Unit 01 [15]
Manufacturing of raw sugar:
Clarification process
Crystallization process
Centrifugal process

Unit 02 [15]
Manufacturing of refine sugar
Types of refineries
Mingling and affination process.
Clarification of refine melt
Evaporation & crystallization
Specification of refine sugar

Unit 03 [12]
Manufacturing of Khandsari sugar
Specification of Khandsari sugar.
Extraction & clarification of cane juice.
Open pan boiling system
Purging drying & packing system.

Unit 04 [12]
Manufacturing of Jaggery & Jaggery powder.
Extraction & clarification of juice
Concetraction of juice to rab
Drying & packing og Jaggery.
Crystallization process o f Jaggery powder.
Curing. drying and packing of Jaggery powder.

Unit 05 [06]
Production of candy sugar
Production of brown sugar
Production liquid sugar.

Reference Books:

1. Hand book of sugar refinery, Chung Chi Chou
2. Manufacture & refining of raw sugar,V. E. Baikow

M. Sc., PART-II (SEMESTAR-IV)
Paper: XV (CEUO) CHEMICAL ENGINEERING (UNIT OPERATION)

Unit 01 **[15]**

1.1 Size reduction

Necessity& mechanism, Rattling's law, kick's law, Bond's law, method of operating crusher, Size reduction in sugar industries.

1.2 Screening

Standard screens, capacity of screen & efficiency, Ideal and actual screen, screen analysis, equipments for industrial screening, sieve test of sugar.

1.3 leaching &extraction

Leaching techniques, perforations through solids bed, stationary bed & moving bed. Counter-current leaching, theory of diffusion. Theory of extraction of juice from cane

Unit 02 **[15]**

2.1 Sedimentation

Law of settling, Stokes law, Batch settling test, Design feature of continuous thickeners, Determination of thickeners area ,factors affecting the settlings rates, Different type of settling equipments. Equipments in sugar industries.

2.2 Mixing & Agitation.

Introduction, classification of mixing equipments and its application. Mixers for mixing the material. (Solid-solid &solid-liquid)

Unit 03 **[15]**

3.1 Filtration

Theory, factors affecting filtration and remedies, filter aid and their use, equipment used in sugar factory (Rotary vacuum filter).

3.2 Centrifugation.

Theory, different types of centrifugals machines –Batch & continuous, their performance study.

3.3 Separation

Cylone separation membrane separation, ultra filtration &reverse osmosis

Unit 04 [15]

4.1Evaporation

Effects of liquid characteristics, Mechanism of heat transfer from condensing steam to boiling liquid, factors affecting heat transfer ,boiling point elevation, Daring's rule, calculation of enthalpy balance for single and multiple effects evaporator.

4.2 Crystallization.
Saturation, solubility and super solubility, nucleation and different nucleation system, Effects of impurities on crystal formation, Crystallization mechanism, crystal growth, agglomeration, breakages and crystal distributions.
4.3 drying, cooling and conveying
General principle rate of drying ,diffusion & capillary theory drying ,drying equipments. Need of cooling, cooling equipments in sugar industries. Types of conveyor, various conveyor used in sugar industries.

ELECTIVE SUBJECTS

M. Sc., PART-II (SEMESTAR-IV)
Paper: XVI Business management & marketing.

Unit 01 [15]

a. Introduction
- ✓ Nature of sugar & allied industries.
- ✓ Flow diagram of sugar manufacturing process from cane.
- ✓ Flow diagram of alcohol production from molasses.
- ✓ Flow diagram of power generation from bagasse.
- ✓ Flow diagram of compost from press mud.
- ✓ Flow diagram of ethanol production from alcohol.
- ✓ Flow diagram of methane from spent wash.

b. Setting of sugar industry
- ✓ Construction of new sugar factory in Public, Privet, Co-operative & Govt. undertaking field
- ✓ Selection of location, licensing norms for aerial distance, market survey of sugar, Environment clearance, Public hearing, industrial licensing & Govt. related policies

Unit 02 [15]

- Manufacturing cost
  Raw material cost, Harvesting &transport cost. Repairing and maintenance cost. Chemical cost. Store consumption cost, packing cost, selling cost, distribution & adm., Expenses. Audit system.
- Financial cost
  Promoters contribution, Govt. contribution, loans from Bank, Govt. subsidy, Tax credit and refunds
  Working capital, Managements –need, sources and determinants

Unit 03 [15]

- Statutory lows applicable to sugar & ailed industries
  - ✓ Essential commodities acts-1955.
  - ✓ Sugar control order -1966.

- ✓ Sugar cane control order -1966.
- ✓ Levy sugar supply order-1979
- ✓ Sugar packing and markting order-1970
- ✓ Sugar developments funds rule-1983.
- ✓ SMP/FRP(statutory minimum price/fair &remunerative price) of sugar cane.
- ✓ SAP (State advisory price) of sugar cane.
- ✓ The amended orders to all above original orders.

- ➢ Labor acts
  - ✓ Grade & scale fixations wage board lows.
  - ✓ Gratuity laws.
  - ✓ Provident lows.
  - ✓ Bonus acts.
  - ✓ Factory acts.
  - ✓ Service tax acts.
- ➢ Excise/taxation acts.
  - ✓ Central excise duty on sugar
  - ✓ State excise duty- on molasses
  - ✓ State excise duty on bagasse and press mud.
  - ✓ Energy lows on power.
  - ✓ Vat on sugar &by products,
  - ✓ GST tax on sugar &by products,

Unit 04 [15]

- ➢ Marketing of sugar & by products.
  - ✓ Introduction-Nature, scope &core concept of marketing.
  - ✓ Marketing planning process.
  - ✓ Marketing segmentation-Meaning, Concept, Benefits &Doubts.
  - ✓ Marketing of sugar-leavy, free export/import, damage sugar, etc.
  - ✓ Marketing of by-product,-Molasses. Bagasse, Press mud.
- ➢ Global &domestic scenario of sugar.
  - ✓ Global production &consumption, Domestic production & consummation.
  - ✓ Indian sugar standard, handling and storing of sugar.

Reference Books:

1. Financial management, Ravi Kishor
2. Cost accounting, Jawaher Lal
3. Marketing management, Tapan Panda

OR

M. Sc., PART-II (SEMESTAR-IV)
Paper: XVI POLLUTION PREVENTION & CONTROL

Unit 01 [15]

- ✓ Importance of environments.
- ✓ Biosphere and layers of atmosphere.
- ✓ Hydrological & nutrient cycles
- ✓ Types of pollution, damages from environmental pollution.
- ✓ Need of environmental legislations and environmental acts.
- ✓ Function of state & central pollution control boards.

Unit 02 [15]

- ✓ Source, classification and characterization of waste water.
- ✓ Physical & chemical characteristics' of waste.
- ✓ BOD, COD and their importance
- ✓ Types of water pollution and their effects.
- ✓ Sampling and method of analysis.

Unit 03 [15]

- ✓ Preliminary, primary, secondary & tertiary treatments of waste water.
- ✓ Sludge treatments and disposal.
- ✓ Advance waste water treatments.
- ✓ Recovery of material from process effluents.
- ✓ Application to industries.
- ✓ Norms and slandered of treated water,

Unit 04 [15]

- ✓ Air pollution-classification and source of air pollution. Air quality criteria and standards effects of air pollution on health vegetation and material, Air pollution control methods. Equipment used in industries.
- ✓ Solid waste treatments-origin, classification and microbiology, properties and their variation. Engineering system for solid waste managements. Generation, Handling, storage collection, transport compositing and land filling.
- ✓ Noise pollution-source and determination of level .noise control criteria and noice exposure indux.adminisretive and engineering control. Acoustic absorptive material.

OR

M. Sc., PART-II (SEMESTAR-IV)
Paper: XVI- WATER MANAGEMENT AND ZERO DISCHARGE.

Unit 01 Water & water treatments [15]

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

Unit 02 Boiler water treatments [15]

Feed water treatment, Condensate treatment, Boiler water treatment.
Boiler blow down, Reasons of boiler failures, Boiler preventive maintenance. Tubes internal chemical cleaning boiler feed & boiler water treatments, boiler water limits. Carryover & priming in boiler.
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Unit 03 Cooling tower & cooling water treatments [15]

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

Unit 04 [15]

a) Automation and instrumentation for safety working at
Water treatment
Effluent treatment
In plant control method
b) Environment acts and guide line.
c) Air pollution; source & control equipments

Reference Books:

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

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

1. In Plant Training-I

Factory Practice (Internship/In-plant Training)
Course: Hard Core, Credit: 06, Report: 50 Marks Exam: 50

LABORATORY PRACTICE
Determination of Brix, Pole & Purity of sugar house products, Special Analysis Experiments. Boiler Water and Effluent Analysis. Boiling House Stock taking, calculation of Recovery%, Preparation of DMR

CANE DEPARTMENT
Organisation and working of the department, staffing pattern, duties of field man, cane supervisor etc., cane area of the factory, cane varieties and their acreage, number of registered farmers, sugarcane planting, crop monitoring, post-harvest maturity survey, Issue of cutting orders and harvesting procedures, managing harvesting labour and cane transport to factory, managing yard balance, measures to reduce cut to crush delay, varietal improvements, farmers education & training under taken.

MILLING
Cane weighing, cane unloading, operation of feeder table & cane carrier, technical information of preparatory devices and their drives, preparatory index achieved, automation of cane feeding, problems faced & maintenance. Cane conveying to mills, rake carriers, belt conveyors, donnelly chute & pressure feeders, inter carriers.
Working of the Mills – crushing rate, rpm of mills, hydraulic load etc., - roller grooving, pitch, Imbibition %, effect of imbibition on capacity and mill extraction, Mill setting Calculations, Brix Curves and its Significance, pumping of Juice, gutters, pumps & piping details – Mill Drives.
Juice Screening – working of rotary screen (Operation, Cleaning & Maintenance), weighing & metering of juice & water, scale. Problems in Milling and remedies (Operational and Mechanical) Importance of Mill Log Book – staffing pattern (Fitters, Helpers etc), Off - seasonal Maintenance.

BOILER
Technical details of boiler, fuel management, operation of boiler, water level control, maintaining boiler pressure, blowdown, furnace Cleaning – Feed water treatment, condensate management, Make

up water, working of DM or RO water plant, Feed pumps – RBC – flue gas heat recovery systems viz., Economiser, Air pre heater – secondary air (SA) fan, Forced draft (FD) fan, Induced Draft (ID) fan, chimney, dust collectors, boiler instrumentation. Bagasse Dryer – construction and working, advantages & disadvantages
Starting of boiler - slow firing, rising the pressure, pressure maintenance – low boiler pressure, back feeding – water high/low other operational problems and solutions. Log book, staffing (boiler attender, fireman, gauge glass attender etc.) Off-seasonal work. Flue gas & boiler water analysis.

POWER HOUSE & ELECTRICAL DEPT.
Turbine, Alternator, AVR-Load distribution – turbine heating, charge over power factor, specific stem consumption-solving problems like priming, low boiler pressure. Power production and distribution, Cogeneration Station, off seasonal job, staffing pattern (Turbine operator, foreman etc.,) Maintenance jobs of Electrical dept – tripping of motors, winding of motors etc.

2. In plant Training-II

CLARIFICATION SECTION
Juice Heating : Arrangement and distribution – heating surface, number to tubes, passes and other design parameters – steam/vapor utilization, temperature control taking and cutting heater from service, juice draining, cleaning, checking – double beet valves etc., - condensate extraction and pumping arrangement, non-condensable gases removal. Operational problems viz., Hammering, problems in pumping, leakage.
Preparation of MOL, lime consumption, capacity, storage and pumping, equipment details. grit removal - classifier, importance of quality of lime.
Production of SO2: Operation of sulphur burner, equipment details, control of sulphur burning rate, temperature controlling, automation of burner. Types of valves, Working of compressor/blower.

SULPHITER: Design of sulphiter, Juice sulphitation technique, proportioning of SO2 gas and MOL, settling test, technical details - capacity, retention time, operation of equipment, draining of juice during stoppage, juice tanks/monds & pumps, Syrup sulphitation.
Off-seasonal maintenance work in the above stations

CLARIFIER: Technical details of clarifier, preparation of flocculant, dosing, flash tank, operation in underflow and overflow, checking juice and mud level, problems in settling, importance of pH & temperature of clear juice, preservation of juice during shut down,

FILTRATION: Technical details, bagacillo blower, cyclone separator, mud mixer, proportioning of mud and bagacillo, operation of filter, creation of vacuum, details of vacuum pump, baby condenser, moisture trap, vacuum regulation(Heavy/Light), filtrate receiver, washing of cake, judging the operation by observing the colour and thickness of the cake. Troubles in filtration, off-seasonal work in the section

EVAPORATION: Working of multiple effect evaporator/falling film evaporator/semikestner, how to start the evaporator, how to distribute the vacuum, juice level regulation, noxious gas removal, condensate extraction, syrup pump trouble, high level in the bodies, vapor bleeding, vacuum problem,

injection pump load checking, condenser spray & jet regulation, pan-evaporator vapor pressure stabilization, syrup load high, other operational problems like vacuum leakage, hammering, low pressure exhaust etc. Working of evaporator before and after cleaning. Heating surface, vapor pipe diameter of different bodies and other design parameters, instrumentation, pressure/vacuum/temperature of each body. Cleaning of evaporator, water test, vacuum test, Hydraulic test etc., off-season work.

PAN FLOOR:
Boiling 'A' massecuite: Quantity of seed, washing and setting of grains, giving drinks, removal of dust, cutting the footing, boiling of massecuite. Managing the syrup, melt, AL load - Checking the brix of the massecuite for dropping, dropping the pan and re starting the pan.
Boiling of B & C massecuite: Graining, graining medium, slurry introduction, hardening, setting the grains, movement water, removal of false grains, boiling the strike massecuite.
Operational problems viz.,: Syrup and molasses load, low vapor pressure, vaccum trouble, want of crystaliser, high temperature boiling, etc., Monitoring the pan floor position, co-ordination between evaporator and panfloor, distribution of pans, capacity utilisation, stream/vapor management during starting and dropping of pans, vacuum crystalliser, seed crystallizer, automation at pans, off-season work.
Working of Spray pond/cooling tower, Injection water pumps, service pump, priming of pump, pump starting, off-season work

CRYSTALLIZER & CENTRIFUGALS
Working of crystallizer, batch/continuous/MVC, distribution of crystallisers, capacity, cooling/reheating, transient heater, air/water cooled crystallizer.

Centrifugals: Type and make, curing of A massecuite, operation of the A centrifugal, operational, mechanical and electrical troubles, curing cold viscous massecuite, operation of continuous centrifugals, controlling of problems. Off-season work.

Sugar Dryer: Working of dryer, drying & cooling, air requirement, conveying, grader, grading of sugar, weighing and bagging, stacking of sugar bags, godown procedures, sugar sales etc. Molasses weighing, Storage, cooling, sales and dispatch.

Effluent Treatment: methods of effluent treatment, norms of various constituents, zero discharge concept, water balance - calculation of water % cane.

GENERAL
Setting up of Sugar Factory, Organizational Structure, History of the factory, welfare activities, corporate social responsibility, functioning of engineering, manufacturing depts., duties and functions of the various section heads. Accounts Dept. - Sugar sales procedure, cost of production of sugar, methods of remuneration, pay role, cane payment etc., Personal Dept., - number of Employees and classification, working of time office. Stores – material arrangement, receipts and Issues, purchase procedures & general administration.

Project Report preparation.

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