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With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416 004,  
MAHARASHTRA

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शिवाजी विद्यापीठ, कोल्हापूर - ४१६ ००४, महाराष्ट्र

दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दूरध्वनी ०२३१-२६०९०९३/९४



SU/BOS/Science/480

Date: 01/07/2023

To,

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

The Head/Co-ordinator/Director  
All Concerned Department (Science)  
Shivaji University, Kolhapur.

**Subject:** Regarding syllabi of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.

**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 revised syllabi, nature of question paper and equivalence of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.


M.Sc. Part-II (Sem. III & IV) as per NEP-2020			
1.	Mathematics	8.	Botany
2.	Mathematics (Distance Mode)	9.	Electronics
3.	Mathematics (Online Mode)	10.	Zoology
4.	M.Sc. Tech (Industrial Mathematics With Computer Application)	11.	Agro Chemical and Pest Management (AGPM)
5.	Geography	12.	Alcohol Technology
6.	Statistics	13.	Sugar Technology
7.	Applied Statistics and Informatics	14.	Geology

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 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)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

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

Thanking you,

  
Dy Registrar  
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	8	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	9	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	10	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	11	Centre for Distance Education

**SHIVAJI UNIVERSITY, KOLHAPUR**



**CHOICE BASED CREDIT SYSTEM**

**Syllabus**

**for**

**M.Sc. Part - II**

**Sugar Technology (Entire)**

**(Under Faculty of Science & Technology)**

**AS PER NEP – 2020**

**(To be implemented from Academic Year 2023 - 24)**

### M.Sc. Part II (Sugar Technology) Sem-III

	<b>Course Code</b>	<b>Paper No.</b>		<b>Title of course</b>	
<b>CGPA</b>	CC301	IX	ST 3.1	Equipment's Capacity Calculation (I & II)	<b>All courses are Compulsory</b>
	CC302	X	ST 3.2	Allied Sugar Manufacturing	
	CC303	XI	ST 3.3	Chemical Engineering (Heat & Momentum Transfer)	
	CC304	XII	ST 3.4	Elective -1) AT - Alcohol Technology 2) BCE-Bio-chemical engineering 3) EIC –Electronics and instruments engineering.	
	CCPR305		STP 3.1	Practical – III	
<b>Non-CGPA</b>	SEC306		STP 3.2	Practical – IV	

**M.Sc. Sugar Technology Part-II (Semester-III)**  
**Paper: IX: Equipment's Capacity Calculation 9 (ST3.1)**

**UNIT – 1**

[15]

**1.1 - 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<sub>2</sub> gas distribution system

**1.2 - Capacity of equipment for process chemical:**

- Capacity of phosphoric acid tank and dosing equipment
- Capacity of lime preparation equipment's and lime pumps
- Capacity of sulphur burner and air compressor

**UNIT – 2**

[15]

**2.1 - Capacity of juice heater:**

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

**2.2 - 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,

**3.1- Capacity of evaporator:**

- Co-efficient of heat transmission
- 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

**3.2 - 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 – 4****4.1 – Centrifugal:**

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

**4.2 - 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) Cane Sugar Manufacturing In India, D. P. Kulkarni

# M. Sc. Sugar Technology Part-II (Semester-III)

## Paper – X: Allied sugar manufacturing (ST3.2)

### UNIT – 1 [15]

#### 1- Manufacturing of Raw Sugar:

- Specification of Raw sugar
- Clarification process
- Crystallization process
- Centrifugal process

### UNIT – 2 [15]

#### 2- Manufacturing of Jaggery & Jaggery Powder:

- Extraction & clarification of juice
- Concentration of juice to rab
- Drying & packing of Jaggery
- Crystallization process of Jaggery powder
- Curing, Drying and packing of Jaggery powder

### UNIT – 3 [15]

#### 3. Manufacturing of Refine Sugar

- Specification of refine sugar
- Types of refineries
- Mingling and affination process
- Clarification of refine melt
- Evaporation & crystallization
- Curing, Drying and packing of refine sugar

### UNIT – 4 [15]

#### 4. Manufacturing of Khandsari sugar

- Specification of Khandsari sugar
- Extraction & clarification of cane juice
- Open pan boiling system
- Purging, drying & packing system

#### Reference Books:

- 1) Hand Book of Sugar Refinery, Chung Chi Chou
- 2) Manufacture & Refining of Raw Sugar, V. E. Baikow

**M. Sc. -Sugar Technology Part II (Semester -III) (ST3.3)**  
**Paper – XI Chemical Engineering Heat and Momentum Transfer**

**Unit -1** **[15]**

**Heat Transfer:**

- Conduction- Mechanism of heat transfer by conduction in solids, Fourier's law of heat transfer, Thermal conductivity, and heat loss in conduction. Thermal insulation and optimum thickness for insulation.
- 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.
- Radiation -heat transfer by radiation. Kirchhoff's law, Stefan-Boltzmann law.

**Unit -2** **[15]**

**Heat Transfer Equipment:**

- Heater – multi-pass shell and tube type heat exchanger-shell, tubes, tube pitch ligaments' (clearance), tube passes, Baffles.
- Condenser - types of condenser co-current & counter current. Derivation of overall heat transfer coefficient from hot fluid to cold fluid Through metal wall.

**Unit -3** **[15]**

**Fluid Transfer:**

- 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
- Fluid flow - Type of fluids, viscosity of gases and liquids, types of flow laminar & turbulent, Reynolds number, basic equation of fluid flow, Average velocity, and mass velocity, continuity equation, flow of incompressible fluids. Laminar flow through circular conduit, turbulent flow through pipes, friction factor.

**Fluid transfer Equipment:**

- **Pumps** – positive displacement and centrifugal pumps, Fans, compressor & 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) Introduction of Chemical Engineering by Badger and Baneo
- 2) Introduction of Chemical Engineering by Ghosal and Sanyal
- 3) Stoichiometry by Bhatt and Vohra



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

**UNIT – 1**

**[15]**

**1.1 - Cane molasses**

- Composition of molasses, gradation of molasses, storage of molasses, factors responsible for reducing the ratio (F/NF) of molasses, other use of molasses.

**1.2 - Definition**

- Molasses, Total reducing sugar, Fermentable/Unfermentable sugar, Residual sugar.
- Wort, Brix, Specific gravity, Distillation, Industrial alcohol, Proof spirit, Strength of spirit, Reflux, Vaporization.
- Saccharification, Scaling, Scrubber, Starch -sucrose, Rectification, Gelatinization, liquefaction, Reboiler.

**UNIT – 2**

**[15]**

**2.1 - 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

**2.2 - Definition & type of fermentor**

- Traditional batch, fed batch & continuous fermentation
- Difference between batch & continuous fermentation.
- Alcohol production from sweet sorghum
- Alcohol production from cane syrup

**UNIT – 3**

**[15]**

**3.1 - 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

### **3.2 - 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.

## **UNIT – 4**

**[15]**

### **4.1 - Distillation equipments**

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

### **4.2 - Effluent treatment system in Distillery**

- Quality of effluent, IS specification of effluent.
- Biological treatments.
- Aerobic treatments,
- Anaerobic treatments

### **4.3 - 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 ENGINEERING**

**UNIT - 1**

**[15]**

**1.1 - Introduction:**

- Bioprocess engineering and technology. An introduction to basic biological science.

**1.2- 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 - 2**

**[15]**

**2.1 - 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.

**2.2- Kinetics of enzyme action:**

- reversible enzyme, two substrate, multi-complexes enzyme kinetics. Experimental determination of rate parameters: Batch & continuous flow experiments, Batch Kinetics.

**UNIT - 3**

**[15]**

**3.1 - 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.

**3.2 - 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.

## **UNIT - 4**

**[15]**

### **4.1 - 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.

### **4.2- Downstream processing:**

- Strategies and steps involved in product purification.
- Methods of cell disruption, filtration, centrifugation sedimentation
- Types of chromatography technique
- Freeze drying /lyophilization & membrane separation processes.

**OR**

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

**Paper: XII-ELECTRONIC & INSTRUMENTS ENGINEERING.**

**UNIT - 1**

**[15]**

**1.1- Basic Electronics:**

- Circuit elements in series & parallel. Semiconductor Devices – Diode as Rectifier, Zener Diode as Voltage Regulator, Transistor as Amplifier. Field Effect Transistor –Jfet & Mosfet. Thyristor – Silicon Controlled Rectifier.

**1.2- Number Systems:**

- Decimal & binary systems, binary addition, subtraction, multiplication, division, use of complement.

**1.3 - Boolean Algebra:**

- Basic laws of Boolean algebra, De-Morgan's theorems, minimization techniques.

**1.4 - Logic Gates:**

- OR, AND, NOT, NOR, NAND, EXOR gates.

**1.5- Arithmetic Logic Units:**

- Half adder, full adder, parallel binary adder and subtractor. Introduction to basic configuration of computer.

**UNIT - 2**

**[15]**

**2.1 - Instrumentation:**

- Introduction, important terms associated with instruments such as range, span, accuracy, error and sensitivity.

**2.2 - Flow measurement:**

- Types of flow, flow transducers - orifice plate, pitot tube, venturimeter. Description of rotameter, magnetic flow meter, ultrasonic flow meter etc.

**2.3 - Temperature measurement-**

- Introduction to filled system thermometers, Expansion thermometers, thermocouples, RTD's, Thermostats and pyrometers.

**UNIT – 3**

**[15]**

**3.1 - Pressure measurement:**

- Various units and their conversion, manometers, Bourdon tube, diaphragm, bellows, capsule, strain gauges for pressure measurement.

### **3.2- Level measurement:**

- Direct methods - float methods, magnetic level indicator, magnetic level switches, indirect method - hydrostatic method, radiation method, ultrasonic method and capacitance method.

## **UNIT - 4**

**[15]**

### **4.1 - pH and conductivity measurement:**

- Introduction, different types of sensors, pH meter and conductivity meter.

### **4.2- 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.

### **4.3 - PLC system, DCS system, SCADA system**

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

### **A) 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
- 5) 2/3 – 10 (2003), ICUMSA Method Book.
- 6) The determination of Conductivity ash in sugar, method GS 2/3 – 17(2002) – ICUMSA Method Book.
- 7) The determination of moisture in sugar method GS 2/1/3–15(2002) – ICUMSA Method Book.
- 8) The determination of reducing sugar in sugar method GS 2/3/9 – 5(2007) ICUMSA Method Book.
- 9) The Determination of Insoluble Matter in White Sugar by Membrane Filtration Method GS 2/3/9 – 19 (2007) ICUMSA Method Book.
- 10) Mesophilic Bacteria in Sugar ICUMSA method GS2/3-41 (1998)
- 11) Yeasts and Moulds in Sugar ICUMSA method GS2/3-47 (1998)

### **B) Sugar Technology-IV (Analysis of Process Chemicals)**

- 1) Analysis of sulphur
  - a. Moisture % sulphur
  - b. Ash % sulphur
  - c. 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<sub>2</sub> 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<sub>2</sub>CO<sub>3</sub>).
- 11) Determine formaldehyde (formaline) content sodium sulphide method.

## M.Sc. Part II (Sugar Technology) Sem-IV

	Course code	Paper No.		Title of course	
CGPA	CC401	XIII	ST4.1	Allied Co-product Manufacturing	All courses are compulsory
	CC402	XIV	ST4.2	Advance sugar technology and engineering	
	CC403	XV	ST4.3	Chemical Engineering (unit operation )	
	CC404	XVI	ST 4.4	Elective -1- ECC-Energy conversion and co generation 2- PPC-Pollution prevention and control 3- WMZD-Water mangment and zero discharge .	
	CCPR405		STP4.1	In-plant Training	
Non CGPA	SEC406		STP4.2	Technical Essay	



**M.Sc. -Sugar Technology Part II (Semester -IV)**  
**Paper – XIII (ACM) Allied Co-Product Manufacturing**

**UNIT –1**

[15]

**1.1 – Molasses:**

- Composition of molasses
- Storage of molasses
- Quality of molasses
- Pre-clarification of molasses
- Molasses for production of alcohol process
- Molasses for production of yeast process
- Molasses for production of acetone process
- Molasses for production of glycerin process
- Molasses for production of cattle feed process
- Other use of molasses in different countries

**UNIT –2**

[15]

**2 - Press Mud (Filter Cake):**

- Composition of filter cake
- Use of filter cake as fertilizer process
- Use of filter cake for production of cane wax process
- Use of filter cake for production of bio-gas process
- Use of filter cake as fuel process
- Use of filter cake as cattle feed process

**UNIT –3**

[15]

**3 – Bagasse:**

- Composition of bagasse
- storage of bagasse
- Separation of pith from bagasse
- Production of pulp and paper from bagasse process
- Production of particle board and fiber board from bagasse process
- Production of corrugated boards and boxes from bagasse process
- Production of furfural from bagasse process
- Production of xylitol from bagasse process
- Production of plastic from lignin in bagasse process
- Production of methane & product gas from bagasse process
- Production of cattle feed from bagasse process
- Other use of bagasse and bagasse ash
- Generation of surplus power from bagasse

**4 - Ethanol Production:**

- Production of ethanol from cane juice and cane syrup
- Extraction of juice process
- Clarification of juice process
- Evaporation process
- Fermentation process
- Distillation process
- Dehydration process

**Reference Books:**

- 1) Ethanol & Distillation by H. C. Barron
- 2) The Book on Sugarcane Processing & By-Products of Molasses – H. Panda.
- 3) Process Synthesis for Fuel Ethanol Production - C. A. Cardona.
- 4) Kale U. M. (1990) Glance at Distillery By-Products DSTA 40<sup>th</sup> Convention

**M.Sc. -Sugar Technology Part II (Semester -IV)**  
**Paper – XIV (ASTE) Advance Sugar Technology & Engineering**

**UNIT –1**

[15]

- Screening of the juice:  
Effect of bagasillo on manufacturing process, its removal by rotary screen & two stage rotary screens, Advantage of rotary Screen
- Juice stabilization & pH control system:  
juice flow stabilization system & Auto pH control system for juice clarification
- New trends in clarification:  
Filtrate and syrup clarification, Advantages of above both processes
- S.R.T:  
Tray less clarifier or short retention time (S.R.T.) Clarifier, construction and working

**UNIT –2**

[15]

- Decanter:  
Muddy juice treatments, construction and working
- Sulphur Burner:  
Film type sulphur burner, Instrumentation and automation for film type sulphur burner.

**UNIT –3**

[15]

- Steam Economy:  
Vapor bleeding and steam economy, Basic requirement of steam, Steam requirement when vapor are used for entire juice heating, Steam requirement when vapor are used for juice heating and pan boiling,
- Pan Automation:  
Pan boiling instrumentation and automation system for batch and continuous pan, Automatic Brix and temperature measurement of molasses conditioner, Automatic Brix and temperature measurement of melter
- Centrifugal Control:  
Auto feed control system for centrifugal, Wash water system for centrifugal

- Mill Efficiency:  
Various factors affecting milling capacity and efficiency
- Mill Control:  
Auto cane feeding control system for uniform feed rate, Automatic imbibitions water flow and temperature control system, Central lubricant system
- Pressure feeding system:  
TRPE, GRPF, UFR
- Two roller mill
- Cane Diffuser  
Heat and mass balance in cane diffuser, construction and working of the diffuser, comparison of cane diffuser with mill
- Co-generation of surplus power and its potential.
- Power saving device  
A.C.VFD drive  
Planetary gearbox
- Heat recovery unit  
Flash recovery system, condensate heat recovery system, H.P heater for High pressure boiler, vapcon system, sulphur burner
- Boiler water Treatment  
Boiler Feed Water Treatment Plant, chemical treatment system

**Reference Books:**

- 1) Hand Book of Sugar Engineering By-H. Eugot
- 2) Hand Book of Cane Sugar By - R. B. L. Mathur
- 3) Cane Sugar Engineering By- Peter Rein
- 4) Machinery and Equipment of Cane Sugar Factory- By Trom

**M.Sc. -Sugar Technology Part II (Semester -IV)**  
**Paper – XV (CEUP) Chemical Engineering –Unit Operation**

**UNIT –1** **[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, equipment for industrial screening, sieve test of sugar.

**UNIT –2** **[15]**

**2.1 - 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

**2.2 - Sedimentation:**

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

**UNIT –3** **[15]**

**3.1 – Evaporation:**

- Theory of evaporation, construction and operation of evaporator bodies.

**3.2 - Mixing & Agitation:**

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

**UNIT –4** **[15]**

**4.1 – Filtration:**

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

**4.2 – Centrifugation:**

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

### **4.3 - Separation**

- Cyclone separation, membrane separation, ultrafiltration & reverse osmosis.

#### **Reference Books:**

- 1) Introduction of Chemical Engineering by Badger and Baneo
- 2) Introduction of Chemical Engineering by Ghosal and Sanyal
- 3) Stoichiometry by Bhatt and Vohra

**M.Sc. -Sugar Technology Part II (Semester -IV)**  
**Paper – XVI (ET) ECC-Energy Conversion & Co-Generation**

**UNIT –1**

[15]

**1.1- Elements of Electro Mechanical Energy Conversion:**

- Introduction, Salient aspects of conversion, Energy Balance, Magnetic field system: Energy and Co-energy, A simple Electro mechanical system, Energy in terms of Electrical Parameters, Rotary Motion, Dynamic Equation and system model of a simple system

**1.2- D.G. Generators:**

- Simple loop generator, Practical Generator ,Yoke,, pole cores and pole shoes, .pole coils Armature core Armature windings Commutator Brushes and Bearings Pole pitch ConductorTypes of Generators, Measurement of generator Efficiency characters tics of generator

**UNIT –2**

[15]

**2.1 - D. C. Motor:**

- Motor Principle, Comparison of Generator and Motor Action,, Significance of the Back e.m.f ,Voltage Equation of a Motor, Condition for Maximum Power, Torque, Armature Torque of Motor, Shaft Torque, Speed of D.C. Motor, Speed Regulation Torque and speed of D.C. Motor, Motor Characteristics, Characteristics of series Motors, Characteristics of Shunt Motors Compound Motors, Performance Curves, Comparison of Shunt Motor and Series Motor Power stages

**2.2 - Speed Control of D.C. Motors:**

- Factors Controlling Motor Speed ,Speed Control of Shunt Motors , Flux Control Method ,Armature or Rheostat Control Method Voltage Control Method Speed Control or series method Flux Control Method Variable Resistance in series with motor Measurement of motor Efficiency

**UNIT –3**

[15]

**3.1– Transformer:**

- Working principle of a Transformer, Transformer Construction Core – type

Transformers. Shell – type Transformers, Elementary Theory of an ideal Transformer, D.M.F. equation of Transformer, Voltage Transformation Ratio (K) Transformer with losses but no magnetic Leakage, Transformer on No-load Transformer on load, Transformer with winding resistance but no magnetic Leakage Magnetic Leakage Transformer with resistance and leakage reactance, Estimation of Transformer Efficiency (at Full Load & Actual Load)

### **3.2- Transformer Three phase:**

- Three – Phase Transformer Connection, Star/star or Y/Y Connection, Delta-delta connection, Wye/delta – connection, Delta/wye connection

## **UNIT –4**

[15]

### **4.1 - Induction Motor:**

- Classification of A.C. Motors, Induction Motor : General Principle & Construction, Squirrel cage rotor, Phase – wound rotor, Production of Rotating Field, Three – Phase Supply, Mathematical proof, Why does the rotor rotate, Slip, Frequency of rotor current, Starting Torque of a squirrel –cage motor, Starting Torque of a slip – ring motor Torque /Speed Curve, Current/speed curve of an induction motor

### **4.2 - Single – Phase Motor**

- Types of single – phase motors, single – phase induction motor, Double – field revolving Theory, Making single – phase induction motor self – starting, Types of capacitor – star motors, Repulsion type motors, Repulsion motor, Repulsion Principle.
- 

### **Reference Books :**

1. Text book of “Electrical Technology” Vol. II , B.L. Theraja & A.K. Theraja , S. Chand Publication
2. “Electrical Machines ” by P.S. Bhimbra



**M. Sc. -Sugar Technology Part II (Semester -IV)**  
**Paper – XVI (ET) PPC-Pollution Presentation and Control**

**UNIT –1** **[15]**

**1- 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 –2** **[15]**

**2- 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 –3** **[15]**

**3- 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 standards of treated water,

**UNIT –4** **[15]**

**4 - 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 fillin
- Noise pollution-source and determination of level .noise control criteria and noice exposure indux.adminisretive and engineering control. Acoustic absorptive material.

OR

**M.Sc. -Sugar Technology Part II (Semester -IV )**  
**Paper – XVI (ET) WMZD-Water Management & Zero Discharge**

**UNIT –1** **[15]**

**1.1 - Water & water treatments:**

- 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 –2** **[15]**

**2 - Boiler water treatments**

- 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.

**UNIT –3** **[15]**

**3 - Cooling tower & cooling water treatments**

- 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 –4** **[15]**

**4- Automation and instrumentation for safety working at**

- Water treatment
- Effluent treatment
- In plant control method
- Environment acts and guide line.
- 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 Albtros hand book

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

### **Practical I: Inplant training Report (4.1)**

- A) FACTORY PRACTICE (INTERNSHIP/IN-PLANT TRAINING)**
- B) CANE DEPARTMENT**
- C) MILLING**
- D) BOILER**
- E) POWER HOUSE & ELECTRICAL DEPT.**
- F) CLARIFICATION SECTION**
- G) SULPHITER**
- H) CLARIFIER**
- I) FILTRATION**
- J) EVAPORATION**
- K) PAN FLOOR**
- L) CRYSTALLIZER & CENTRIFUGALS**
- M) CENTRIFUGALS**
- N) SUGAR DRYER**
- O) EFFLUENT TREATMENT**

### **Practical II: Project Report on a particular subject. (4.2)**

## Nature of Question Paper for Theory and Practicals:

	<b>Theory paper</b>	<b>Total -80 marks</b>
1	<p>a) Q.1 Answer in one sentence types of question.</p> <p>b) Q2, Q3 &amp; Q4 will be in section I and attempt any two from this section.</p> <p>c) Q5, Q6 &amp; Q7 will be in section II and attempt any two from this section.</p>	<p>16 marks</p> <p>Each Question 16 marks</p> <p>Each Question 16 marks</p>
2	Internal exam - It consists of 20 questions for 1 mark each.	20 marks
3	Practical Examination will be Annual (Sem III-200 + Sem IV-200)	400 marks
4	<p><b>STP3.1</b></p> <p>Major Practical Minor practical Spotting Viva Journal</p> <p><b>STP3.2</b></p> <p>Major Practical Minor practical Journal Spotting Viva</p>	<p>40 Marks 20 marks 20 marks 10 marks 10 marks</p> <p>40 Marks 20 marks 10 marks 20 marks 10 marks</p>
5	<p><b>STP4.1:</b> Inplant Report Presentation and viva</p> <p><b>STP4.2:</b> Project Report Presentation and viva</p>	<p>75 Marks 25 Marks 75 Marks 25 Marks</p>