

### Programme Outcomes- M.Sc.

After the completion of two year post-graduation program students will be able to acquire the following attributes.

<b>PO 1</b>	<b>Domain Knowledge-</b> Acquire advanced knowledge of in distillery scientific principles, theories, models and methods in the disciplines of their study.
<b>PO 2</b>	<b>Application-</b> Able to use scientific knowledge and tools deriving from domain knowledge alcohol production and sugar manufacturing .
<b>PO 3</b>	<b>Problem Analysis-</b> Able to identify, formulate and analyze complex problems and find out working solutions using scientific knowledge and tools distillery and sugar industry.
<b>PO 4</b>	<b>Project Management-</b> Able to handle individual and/or group tasks and use critical thinking, problem solving and research-related skills distillery and sugar industry.
<b>PO 5</b>	<b>Individual and Team work-</b> Able to function effectively as an individual and as a member in diverse teams and in multidisciplinary settings distillery and sugar industry.
<b>PO 6</b>	<b>Communication Skills-</b> Able to communicate effectively with the surrounding people and society at large and write reports, documents and make effective presentations distillery and sugar industry.
<b>PO 7</b>	<b>Social Awareness-</b> Able to demonstrate social values through acts of social commitment, display professional ethics and responsibilities showing appropriate consideration for public health, safety and welfare distillery and sugar industry.
<b>PO 8</b>	<b>Social Awareness-</b> Able to demonstrate social values through acts of social commitment, display professional ethics and responsibilities showing appropriate consideration for public health, safety and welfare distillery and sugar industry.
<b>PO 9</b>	<b>Ethics and Human Values-</b> Able to acquire human values and integrity of character and display moral behaviour distillery and sugar industry.
<b>PO 10</b>	<b>Lifelong Learning-</b> Able to recognize the need for and have the ability to engage in an independent and life-long learning in the context of drastic technological changes.

### Programme Outcomes- B.Sc.

After the completion of three year graduation, students will be able to acquire the following attributes.

<b>PO 1</b>	<b>Domain Knowledge-</b> Acquire knowledge of fundamentals, models, basic scientific principles and methods in sugar industry .
<b>PO 2</b>	<b>Application-</b> Able to apply fundamentals, techniques, skills and tools of sciences in new contexts sugar industry.
<b>PO 3</b>	<b>Analysis-</b> Able to analyse problems scientifically and find solutions sugar industry.
<b>PO 4</b>	<b>Project Management-</b> Able to undertake projects/tasks, plan and implement effectively sugar industry.
<b>PO 5</b>	<b>Individual and Team Work-</b> Able to work both as an individual and together with people of different socio-cultural backgrounds sugar industry.
<b>PO 6</b>	<b>Communication Skills-</b> Able to use proper communication skills for successful interaction in personal and public life sugar industry.
<b>PO 7</b>	<b>Social Awareness-</b> Able to undertake activities informed by social values (such as social equity), social issues and cultural diversity sugar industry.
<b>PO 8</b>	<b>Environment and Sustainability-</b> Develop consciousness to preserve the earth's finite resources and balance human needs and the environment sugar industry.
<b>PO 9</b>	<b>Ethics and Human Values-</b> Apply ethical principles and appreciate the importance of ethical practices in professional life and uphold human dignity sugar industry.
<b>PO 10</b>	<b>Lifelong Learning-</b> Able to acquire emerging knowledge and skills and adapt to the changing needs of the times sugar industry.

## SCIENCE

### M.Sc. Alcohol Programme Specific Outcomes

After the completion of the two year postgraduate programme in Agrochemicals and Pest Management, students will be able to -----.

<b>PSO 1</b>	Learn about Alcohol Production and Sugar Manufacturing and sugar structure, chemical names and physical and chemical properties.
<b>PSO 2</b>	Gain knowledge about soil formation, soil profile, soil properties and composition. Sugar properties, alcohol properties.
<b>PSO 3</b>	Understand general characteristics, morphology and physiology of microorganism, plant virus and viral diseases, disease management and control.
<b>PSO 4</b>	Acquire knowledge of production of Alcohol and Sugar, marketing and planning.
<b>PSO 5</b>	Understand the concept of ecology and interrelationship among

### M.Sc. Alcohol Programme Specific Outcomes

#### M.Sc.I Semester-I Paper I- Alcohol Technology I

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand chemical Properties of alcohol
<b>CO 2</b>	Learn alcohol structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of alcohol formulations.
<b>CO 4</b>	Acquire skill of using different devices which are used in alcohol application.
<b>CO 5</b>	Get knowledge about recent advances in ethanol plantation

#### Paper II Semester I Microbiology

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand types microorganism.
<b>CO 2</b>	Learn bacterial structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of yeast formulations.
<b>CO 4</b>	Acquire skill of using different devices which are used in sanitation application.
<b>CO 5</b>	. CO 5 Get knowledge about recent advances in contamination control

#### Paper III Semester I Applied chemistry

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand chemical alcohol.
<b>CO 2</b>	Learn carbohydrate protein structure chemical names and physical and chemical properties.

<b>CO 3</b>	Acquire knowledge of roll alcohol formulations.
<b>CO 4</b>	Acquire skill of using different devices which are used in alcohol application.

### **Paper IV Semester I Biochemistry**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand chemical pesticides and botanical pesticides.
<b>CO 2</b>	Learn pesticide structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of pesticide formulations.
<b>CO 4</b>	Acquire skill of using different devices which are used in pesticide application.
<b>CO 5</b>	Get knowledge about recent advances in pest control

#### **M.Sc. I Semester-II**

### **Sub – Alcohol Technology 2**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Basic of distillation
<b>CO 2</b>	Learn alcohol structure chemical names and physical and chemical properties. Fermentation
<b>CO 3</b>	Acquire knowledge of alcohol formulations and fermentation .
<b>CO 4</b>	Acquire skill of using different devices which are used in alcohol application.
<b>CO 5</b>	Get knowledge about recent advances in ethanol plantation

### **Sub – Applied instrumentation**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand instrument basic measurement system .
<b>CO 2</b>	Learn instrumentation structure physical variable and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of analytical instrumentation.
<b>CO 4</b>	Acquire skill of using different devices which are used in pesticide application.
<b>CO 5</b>	Get knowledge about electronic system and control system

### **Sub – industrial fermentation**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand basics of fermentation .
<b>CO 2</b>	Learn types of fermentation structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of cell mobilization .
<b>CO 4</b>	Acquire skill of using different biochemistry of alcohol technology .
<b>CO 5</b>	Get knowledge about recent advances in carbon source of alcohol

### **Sub – Microbiology**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand isolation and identification and mantantains of yeast .
<b>CO 2</b>	Learn yeast structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge production yeast strain and strain improve .

<b>CO 4</b>	Acquire skill of using different devices which are used in pesticide application.
<b>CO 5</b>	Get knowledge about recent advances hygiene in alcohol industry

### M.Sc. II Semester-III

#### Sub – Alcohol Technology 3

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand principle and application of alcohol technology .
<b>CO 2</b>	Learn alcohol from non molasses source and manufacturing of malt , alcohol and cost of alcohol production .
<b>CO 3</b>	Acquire knowledge of alcohol formulations.
<b>CO 4</b>	Acquire skill yeast & its uses .
<b>CO 5</b>	Get knowledge about molecular sieves

#### Sub – Microbiology

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand history & development microorganism .
<b>CO 2</b>	Learn single cell protein .
<b>CO 3</b>	Acquire knowledge of antibiotics .
<b>CO 4</b>	Acquire skill of using different devices which are used in pesticide application.
<b>CO 5</b>	Get knowledge about recent advances in pest control

#### Sub – ( chemical engineering)

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Water quality surface water ,ground water drinking .
<b>CO 2</b>	Learn pump, centrifugal .
<b>CO 3</b>	Acquire heat exchanger unit .
<b>CO 4</b>	Acquire skill general engineering .
<b>CO 5</b>	Get knowledge about recent advances steam generation system

#### Sub – Elective (industrial waste water ,pollution prevention control ,sugar technology )

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand <b>industrial waste water ,pollution prevention control ,sugar technology</b> .
<b>CO 2</b>	Learn Industrial water structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of waste water treatment .pollution control formulations.
<b>CO 4</b>	Acquire skill of using different devices which are used in pesticide application.
<b>CO 5</b>	Get knowledge about recent advances in pollution control

M.Sc. II Semester-IV

**Sub – Alcohol Technology 4**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand alcohol production from grain .
<b>CO 2</b>	Learn alcoholic beverages.
<b>CO 3</b>	Acquire knowledge table wine formulations.
<b>CO 4</b>	Acquire skill of using different fruit and honey wine .
<b>CO 5</b>	Get knowledge about recent advances in pest control

**Sub – Alcohol Technology 5**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand manturing of ENA .
<b>CO 2</b>	Learn ENA structure chemical names and physical and chemical .
<b>CO 3</b>	Acquire knowledge of IMFL (Wisaky rum gin and vodaka.
<b>CO 4</b>	Acquire skill of manufacturing of the country liquor .
<b>CO 5</b>	Get knowledge about recent advances in pest control

**Sub – Fermentation Technology**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand basics of fermentation .
<b>CO 2</b>	Learn types of fermentation structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of cell mobilization .
<b>CO 4</b>	Acquire skill of using different biochemistry of alcohol technology .
<b>CO 5</b>	Get knowledge about recent advances in carbon source of alcohol

**Sub – Elective subject**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand chemical pesticides and botanical pesticides.
<b>CO 2</b>	Learn pesticide structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of pesticide formulations.
<b>CO 4</b>	Acquire skill of using different devices which are used in pesticide application.
<b>CO 5</b>	Get knowledge about recent advances in pest control

## SCIENCE

### M.Sc. Sugar Technology (ST) Programme Specific Outcomes

After the completion of the two year postgraduate programme in Agrochemicals and Pest Management, students will be able to -----.

<b>PSO 1</b>	Learn about Alcohol Production and Sugar Manufacturing and sugar structure, chemical names and physical and chemical properties.
<b>PSO 2</b>	Gain knowledge about soil formation, soil profile, soil properties and composition. Sugar properties, alcohol properties.
<b>PSO 3</b>	Understand general characteristics, morphology and physiology microorganism, plant virus and viral diseases, disease management and control.
<b>PSO 4</b>	Acquire knowledge of production of Alcohol and Sugar, marketing and planning.
<b>PSO 5</b>	Understand the concept of ecology and interrelationship among

### M.Sc. Sugar Technology (ST) Programme Specific Outcomes

#### M.Sc. I Semester-I Paper I- D) Paper: I(SCA)-Sugarcane Agriculture

At the end of the course, students will be able to -----	
CO 1	<b>Introduction:</b> Origin of Cane, cultivation in India, varieties, climatic conditions, sugarcane agroclimatic zones in India. Sugarcane pricing and payment,
CO 2	<b>Soil:</b> Types, properties – Visual & morphological properties, analytical properties, fertility & soil problems, sustaining fertility, soil conservation practices,
CO 3	<b>Planting:</b> Preparatory tillage, planting time, selection of seedcane, methods of planting - Flat, ridges & furrows, trench, IISR 86206, ring, spaced Transplanting & polybag seedling Transplanting method.
CO 4	<b>Frowth of Sugarcane:</b> Germination, development of shoot & root - factors affecting, tillering, growth of leaves, internodes & stem, factors influencing cane growth, formation and storage of sugarcane.
CO 5	Get knowledge about recent advances in ethanol plantation

<b>Paper–II Sugar Processing- Clarification&amp;Evaporation Unit</b>	
At the end of the course, students will be able to -----	
CO 1	Acquire knowledge of Introduction of sugar industry & flow chart of sugar manufacturing process, Extraction of juice from cane, Maceration or imbibitions
CO 2	Acquire knowledge of 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,
CO 3	Acquire knowledge 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
CO 4	Acquire knowledge of 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
CO 5	Acquire knowledge of Treatment of syrup, Construction and working of syrup sulphitor, Scale formation and removal

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

At the end of the course, students will be able to -----	
CO 1	Acquire knowledge of Cane weighbridges: types, capacity etc. Cane handling and feeding Cane unloading - Bridge with trolley – having sling bar system – two motion/three motion, auto de-hooking system
CO 2	Acquire knowledge of Cane preparations Preparation of cane, various devices of cane preparation like kicker, chopper, leveler, cutter fibrizer and shredder
CO 3	Acquire knowledge of Mills and mill components – Conventional three roller mill.
CO 4	Acquire skill of using Mill drive types with merit and demerit, Mill power requirement, Mill gearing, Mill couplings and tail bars
CO 5	Get knowledge about recent advances sugar technology

### **Paper-IV(CC)CHEMICAL CONTROL**

At the end of the course, students will be able to -----	
CO 1	Technical definition mill and boiling house Fundamental formula mill and boiling house
CO 2	Acquire knowledge of Calculation for mill house
CO 3	Acquire knowledge of Calculation for run report Pol, Brix, Non – sugar balance, Clarification efficiency & clarification factor, Stock taking & available sugar, Boiling house losses, Equivalent standard granulated. (ESG), Conversion of raw sugar recovery into white sugar recovery by using ESG formula, Virtual final molasses



	purity, Operation including & excluding stoppage
<b>CO 4</b>	Acquire skill of Calculation for boiling house
<b>CO 5</b>	Get knowledge about recent advances in pest control

### M.Sc. I Semester-II

### Paper-I (M.SC) SUGAR CHEMISTRY

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand chemical Properties <b>Carbohydrates</b> –
<b>CO 2</b>	Acquire knowledge of <b>Proteins &amp; Amino acids</b> – Learn alcohol structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of <b>Sucrose</b> – formulations.
<b>CO 4</b>	Acquire skill of using different devices <b>Sugar Derivatives &amp; Sugar Alcohols</b>
<b>CO 5</b>	Get knowledge about recent advances in ethanol plantation

### Sub – Applied instrumentation

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand instrument .
<b>CO 2</b>	Learn pesticide structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of pesticide formulations.
<b>CO 4</b>	Acquire skill of using different devices which are used in pesticide application.
<b>CO 5</b>	Get knowledge about recent advances in pest control

### Paper:II (SP-CF)-Sugar Processing–Crystallisation & Finishing

At the end of the course, students will be able to -----	
<b>CO 1</b>	Theory of crystallization & its zones, Grain & graining methods, Principles & practices in graining process, Mechanism of pan boiling, Different massecuite boiling scheme, Principles and practices in pan boiling.
<b>CO 2</b>	Learn Construction of pan, Types of pan, Pan control & instrumentation, Cobenze's method for purity control, Calculations of massecuite % cane & molasses % cane by solid balance, Determination of crystal % massecuite, Determination of crystal size, volume and surface area, termination of steam requirement
<b>CO 3</b>	Acquire knowledge of Centrifugal operations - Screen washing, Sugar washing, Massecuite charging, Separation of light and heavy molasses, Spinning and drying, Discharging Superheated wash water system
<b>CO 4</b>	Acquire skill of using Screen washing,
<b>CO 5</b>	Get knowledge about recent advances in pest control

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

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand <b>Steam Generation: (Boiler)</b>
<b>CO 2</b>	Learn <b>Boiler Instrumentation &amp; Control-</b>
<b>CO 3</b>	Acquire knowledge <b>Boiler water treatment -</b>
<b>CO 4</b>	Acquire skill of using <b>Power generation and Alternator</b>
<b>CO 5</b>	Get knowledge about recent advances in pest control

M.Sc. II Semester-III

### **Sub – Paper: IX (ECC)- Equipment's & capacity calculation**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Capacity of weighing scale and reaction tank.
<b>CO 2</b>	Learn Capacity of equipment for process chemical
<b>CO 3</b>	Acquire knowledge of Capacity of juice heater
<b>CO 4</b>	Acquire skill of Capacity of evaporator
<b>CO 5</b>	Get knowledge about Vacuum pan Pan capacity

### **Paper – X (ASM) Allied sugar manufacturing.**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Heat transfer
<b>CO 2</b>	Learn Heat transfer equipment's
<b>CO 3</b>	Acquire knowledge of Fluid transfer
<b>CO 4</b>	Acquire skill of using Manufacturing of Jaggery&Jaggery powder.
<b>CO 5</b>	Get knowledge about Manufacturing of branded sugar

### **Paper – XI (CEHMT) Chemical engineering heat and material transfer**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand chemical pesticides and botanical pesticides.
<b>CO 2</b>	Learn pesticide structure chemical names and physical and chemical properties.
<b>CO 3</b>	Acquire knowledge of pesticide formulations.
<b>CO 4</b>	Acquire skill of using different devices which are used in pesticide application.
<b>CO 5</b>	Get knowledge about recent advances in pest control

**Paper – XII (ET) AT-Alcohol Technology( Elective 1)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand a)Cane molasses
<b>CO 2</b>	Learn b)Definition of
<b>CO 3</b>	Acquire knowledge a) Defination& type of fermentor
<b>CO 4</b>	Acquire skill of b) Propagation of pure yeast culture.
<b>CO 5</b>	Get knowledge a)Types of distillation process

M.Sc. II Semester-IV

**Sub – Paper – XII (ET) BCE-Bio-chemical engineering (Elective 2)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand <b>Introduction:</b> Bioprocess engineering and technology. An introduction to basic biological science
<b>CO 2</b>	Learn Enzymes and proteins:
<b>CO 3</b>	Acquire knowledge of <b>Fermentation Technology</b>
<b>CO 4</b>	Acquire skill of using Downstream processing:
<b>CO 5</b>	Get knowledge about recent advances in pest control

**Sub – Paper – XII (ET) EIC –Electronics and instrument engineering.(Elective 3)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	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.
<b>CO 2</b>	Learn Instrumentation: Introduction, important terms associated with instruments such as range, span, accuracy, error and sensitivity.
<b>CO 3</b>	Acquire knowledge of Pressure measurement - Various units and their conversion, manometers, Bourdon tube, diaphragm, bellows, capsule, strain gauges for pressure measurement.
<b>CO 4</b>	Acquire skill of 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.
<b>CO 5</b>	Get knowledge about recent advances in pest control

### Sub – Paper – XIII (ACM) Allied Co Product Manufacturing

At the end of the course, students will be able to -----	
CO 1	Understand Molasses Composition of molasses, storage of molasses, Quality of molasses –pre clarification of molasses,
CO 2	Learn Bagasse Composition of bagasse, storage of bagasse, Separation of pith from bagasse,
CO 3	Acquire knowledge 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,
CO 4	Acquire skill of using Ethanol production Production of ethanol from cane juice and cane syrup –extraction of juice process .clarification of juice process .evaporation process, fermentation process.
CO 5	Get knowledge about recent advances in Ethanol production

#### Sub – Elective subject

### Paper – XIV (ASTE) Advance sugar technology and engineering

At the end of the course, students will be able to -----	
CO 1	Understand □ screening of the juice Effect of bagasillo on manufacturing process, its removal by DSM screen, rotary screen & two stage rotary screens, Advantage of rotary Screen .
CO 2	Learn Juice stabilization & pH control system On line mass flow meter for juice weighment, Auto pH control system for juice clarification.
CO 3	Acquire knowledge of Cane diffuser
CO 4	Acquire skill of Mill Efficiency
CO 5	Get knowledge about recent advances in pest control

#### B.Sc. I Semester-I

### Sub –Applied chemistry (sugar chemistry& biochemistry) PAPER I&II

At the end of the course, students will be able to -----	
CO 1	Introduction – Etymology, History: accent time, middle age & modern. Chemistry of sugar, Constituents of sugar, Natural polymers of sugars, Flammability of sugar. Types of sugar, Monosaccharide’s – Glucose, Fructose, Disaccharides –sucrose .lactose. &maltose.
CO 2	Acquire knowledge Forms of sugar and its use .Health effects of sugar- Blood glucose level - Obesityand Diabetics, Cardiovascular disease- Alzheimer’s disease Tooth decays -

	Addiction forming Hyper activity- Measurement
<b>CO 3</b>	Acquire knowledge Physical & Chemical properties of sugar. Physical properties of sucrose-structure of sucrose molecule .sucrose derivative, decomposition of sucrose..
<b>CO 4</b>	Acquire knowledge Chemical properties of sucrose, sucrose molecule, crystalline sucrose, amorphous sucrose, aqueous sucrose.
<b>CO 5</b>	Acquire knowledge Physical properties of reducing sugar :- Physical properties of reducing sugar(dextrose & laevulose) solubility, density, refractive index, optical rotation Chemical properties of reducing sugar( dextrose & laevulose) with organic reagent: Acetone, benzoic, carbonate, acetate.
<b>CO6</b>	Acquire knowledge Introduction to living cells, classifications of living cells, structure and function of cells, Structure and typical characteristics of DNA & RNA. Proteins : Characteristics and classifications of proteins, protein structure, proteins in sugarcane juice. Amino acids: Classifications and properties, Amino acids insugarcane juice and molasses.

### **Sub –PHYSICS (Properties of Material & Thermodynamics)I&II**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Acquire knowledge Surface tension Explanation of surface tension : Angle of contact and wettability, relation between surface tension, excess of pressure and radius of curvature, excess pressure in soap bubble and rise of liquid in capillary, effect of surface tension on evaporation and condensation, effect of impurity and temperature on surface tension.
<b>CO 2</b>	Acquire knowledge Fluid Dynamics & Viscosity General concept of fluid flow, streamline and turbulent flow, the equation of continuity, Bernoulli's equation, its application to venturimeter. Coefficient of Viscosity, flow of liquid through the capillary tube, poiseuilles e, searle's viscometer, determination of viscosity by ostwald's viscometer.
<b>CO 3</b>	Harvesting: Manual & mechanical harvesting of cane, transportation of cane, post harvest deterioration of sugarcane – causes, effect & losses, effect of extraneousMolecule confirm Mean free path and its calculation (approximate method), ideal & real gases, deviation from ideal gas (Boyles law), Vander Waal's equation for real gas. Interpretation of temperature Andrew's curve , critical point, critical constants and their relation with Vander Waal's constants, reduced equation of state.
<b>CO 4</b>	Acquire knowledge ThermodynamicsIdea of thermodynamic equilibrium, isothermal and processes, Carnot's cycle, its efficiency and Carnot's theorem (heat engine), second law of thermodynamics, reversible and irreversible processes, entropy, its physical

	significance, entropy changes during fusion of a solid and vaporization of a liquid.
<b>CO 5</b>	Acquire knowledge DiffractionTypes of diffraction, plane diffraction grating, construction, theory and its application to determine wavelength of light, resolving power, power of plane grating.
<b>CO6</b>	Acquire knowledge PolarizationIdea of polarization, polarization by reflection, Brewster's law, polarization by refraction, pile of plates, double refraction, Huygens ex of refraction, Nicol prism, optical rotation – lens of rotation of place of polarization, half shade polarimeter.

**Sub – Applied Maths: (Algebra and Geometry)I&II**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Acquire knowledge General equation TheoryGeneral equation of plane, normal form intercept form, two parallel planes, Angle between two planes. Equation of a plane, passing through a point. Direction of normal to the plane, plane passing through three points. Distance of a point from plane, straight line in three dimensional. Equation of straight line symmetric form of equation of straight line Inter section of line & plane line passing through a point at perpendicular to given plane. Intersection of two lines, image of a point in a plane.
<b>CO 2</b>	Acquire knowledge Trigonometric ratios.Trigonometric ratios of some standard angles. Trigonometric identities & their derivations.
<b>CO 3</b>	Acquire knowledge Determinants and matricesEvaluation of determinants. Fundamental properties of determinants. Cramer's rule. Solutions of homogeneous & non-homogeneous equations. Types of matrices. Algebra of matrices, multiplication of matrices. Inverse of a matrix, application of matrices to solve system of simultaneous equations. Rank of a matrix.
<b>CO 4</b>	Acquire knowledge Acquire skill FunctionTypes of functions. Algebraic functions, exponential functions, trigonometric functions, logarithmic functions. Algebra of functions. Increasing & decreasing functions. Concept of limit. Limit of a function. Algebra of limits. Method of evaluation of limits. Evaluation of limit of a function at infinity. Continuity of a function
<b>CO 5</b>	Acquire knowledge Derivative of a function. Derivative of some standard functions from first principle. Algebra of derivatives, rules of differentiation with regards to sum, product, difference & quotient of two functions. Derivative of some simple composite function, chain rules. Second order derivatives. Maxima & minima of a function of single variable and two variables. Application of derivatives tangent & normal, velocity & acceleration.

## Sub – Sugar Cane Agriculture:(Sugar cane cultivation & agronomy)&Pathology

At the end of the course, students will be able to -----	
<b>CO 1</b>	Acquire knowledgeIntroduction: Origen of Cane, cultivation in India, varieties, climatic conditions, sugarcane agro climatic zones in India. Maharashtra state statistics of cane. Sugar cane pricing and payment,, cane as bio- fuel. Internal and external morphology of cane
<b>CO 2</b>	Acquire knowledgeCultivation practices.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 Weeds: common weeds, aquatic weeds ,loss due to weeds , method to weed control (mechanical, manual &biological) integrated weed management. Measure to reduced weed..
<b>CO 3</b>	Acquire knowledge 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.
<b>CO 4</b>	Acquire skill Irrigation: Water requirement, scheduling, method of irrigation – surface, overhead or sprinkler, drip irrigation, water quality, water logging, drainage – side, main & infield drains.of using different devices which are used in pesticide application.
<b>CO 5</b>	Maturing: Cane nutrition, functions of macro & micro (trace) nutrients, fertilizers – N, P, K, S, Ca& Mg carriers, Mixed or compound fertilizers, biofertilizers, foliar applications,fertigation, organic & green maturing, time & method of application, visual symptoms of nutrient deficiencies and disorders.

B.Sc. I Semester-II

**Subject: Applied Chemistry: III (DCS ST9)**  
(Organic Chemistry)

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand <b>Introduction:</b> Sugar and Polysaccharides:
<b>CO 2</b>	Learn Organic acids & Polyphones
<b>CO 3</b>	Acquire knowledge of <b>Solution &amp; Strength of Solution: [12]</b> • Definitions of the terms: Soltue, solvent,
<b>CO 4</b>	Acquire skill of using Distribution Law:
<b>CO 5</b>	Get knowledge about <b>Analytical Chemistry and Chromatography:</b>

**Applied Physics: III (DSC ST11)**  
**(Basic Instrumentation)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction to Instrumentation:</b>
<b>CO 2</b>	Liquid and Temperature Measurement:
<b>CO 3</b>	Acquire knowledge <b>Liquid level measurement:</b> Direct Method: Liquid level indicators, Direct Method: Hook type, sight glass, float type.
<b>CO 4</b>	Acquire skill of <b>Pressure and flow Measurement:</b> .
<b>CO 5</b>	Get knowledge about recent advances in pest control

**Subject: Applied Physics: IV (DSC ST12)**  
**(Sugar Instrumentation)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Signal Conditioner:
<b>CO 2</b>	Learn Flame Photometer:
<b>CO 3</b>	Acquire knowledge <b>Polarimetry:</b> Introduction, Plane polarized light, Instrumentation system of polarimetry, Application of polarimetry in sugar Technology, Refractometer, Introduction Snell's Law – Specific refraction
<b>CO 4</b>	Acquire skill of using <b>pH &amp; Conductivity measurements:</b> pH meter, Instrumentation of pH meter, Conductivity meter Instrumentation of conductivity meter, Wheatstone bridge circuit, conductivity cell application
<b>CO 5</b>	Get knowledge about recent advances in Ethanol production

**Subject: Applied Mathematics: III (DSC ST13)**  
**(Descriptive statistics)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Meaning and scope of statistics, Population and Sample, concept of sample with illustrations, methods of sampling. <b>Data:</b> Raw data, Attributes and variables, discrete and continuous variables, frequency distribution.
<b>CO 2</b>	Moments and Measures of Skewness and Kurtosis:
<b>CO 3</b>	Acquire knowledge of <b>Raw and central moments</b> (only first four moments), Relation between central and raw moments, <b>Skewness:</b> Skewness of a frequency distribution, positive and negative skewness, Measures of skewness based on moments.
<b>CO 4</b>	Acquire skill of <b>Correlation and regression</b>
<b>CO 5</b>	Get knowledge about recent advances (Descriptive statistics)



**Subject: Applied Mathematics: IV (DSC ST14)**  
(Probability Theory)

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction to Probability:</b>
<b>CO 2</b>	Univariate probability distributions
<b>CO 3</b>	Acquire knowledge <b>Discrete uniform distribution:</b> pmf, mean & variance. Binomial distribution: pmf, mean & variance, additive property, recurrence relation for probabilities. Hyper geometric distribution:
<b>CO 4</b>	Acquire skill of <b>Pressure and flow Measurement:</b> .
<b>CO 5</b>	Get knowledge about recent advances in (Probability Theory)

**Subject: Sugar Cane Agriculture: III (DSC ST15)**  
(Sugar cane cultivation & agronomy)

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Farm Implements and Machinery In Sugarcane Cultivation, Strategies for Transfer of Technology in Sugarcane Agriculture, The different operations carried out during sugarcane planting are
<b>CO 2</b>	Learn Flame Photometer:
<b>CO 3</b>	Acquire Agricultural economics: Farm management, scope, importance and characteristics,
<b>CO 4</b>	Acquire skill of using Agriculture technology -
<b>CO 5</b>	Get knowledge about recent advances in Ethanol production

**Subject: Sugar Cane Agriculture: IV (DSC ST16)**  
(Sugar cane Pathology)

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Meaning and scope of statistics, Population and Sample, concept of sample with illustrations, methods of sampling. <b>Data:</b> Raw data, Attributes and variables, discrete and continuous variables, frequency distribution.
<b>CO 2</b>	Moments and Measures of Skewness and Kurtosis:
<b>CO 3</b>	Acquire knowledge of <b>Raw and central moments</b> (only first four moments), Relation between central and raw moments, <b>Skewness:</b> Skewness of a frequency distribution, positive and negative skewness, Measures of skewness based on moments.
<b>CO 4</b>	Acquire skill of <b>Correlation and regression</b>
<b>CO 5</b>	Get knowledge about recent advances (Descriptive statistics)

**Applied Physics: III (DSC ST11)**  
**(Basic Instrumentation)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction to Instrumentation:</b>
<b>CO 2</b>	Liquid and Temperature Measurement:
<b>CO 3</b>	Acquire knowledge <b>Liquid level measurement:</b> Direct Method: Liquid level indicators, Direct Method: Hook type, sight glass, float type.
<b>CO 4</b>	Acquire skill of <b>Pressure and flow Measurement:.</b>
<b>CO 5</b>	Get knowledge about recent advances in pest control

**Subject: Applied Physics: IV (DSC ST12)**  
**(Sugar Instrumentation)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Signal Conditioner:
<b>CO 2</b>	Learn Flame Photometer:
<b>CO 3</b>	Acquire knowledge <b>Polarimetry:</b> Introduction, Plane polarized light, Instrumentation system of polarimetry, Application of polarimetry in sugar Technology, Refractometer, Introduction Snell's Law – Specific refraction
<b>CO 4</b>	Acquire skill of using <b>pH &amp; Conductivity measurements:</b> pH meter, Instrumentation of pH meter, Conductivity meter Instrumentation of conductivity meter, Wheatstone bridge circuit, conductivity cell application
<b>CO 5</b>	Get knowledge about recent advances in Ethanol production

**Subject: Applied Mathematics: III (DSC ST13)**  
**(Descriptive statistics)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Meaning and scope of statistics, Population and Sample, concept of sample with illustrations, methods of sampling. <b>Data:</b> Raw data, Attributes and variables, discrete and continuous variables, frequency distribution.
<b>CO 2</b>	Moments and Measures of Skewness and Kurtosis:
<b>CO 3</b>	Acquire knowledge of <b>Raw and central moments</b> (only first four moments), Relation between central and raw moments, <b>Skewness:</b> Skewness of a frequency distribution, positive and negative skewness, Measures of skewness based on moments.
<b>CO 4</b>	Acquire skill of <b>Correlation and regression</b>
<b>CO 5</b>	Get knowledge about recent advances (Descriptive statistics)

B.Sc. II Semester-III

**DSC-ST 17: Sugar Engineering (Mill house)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction to Cane handling and preparation</b>
<b>CO 2</b>	Cane unloading -Bridge with trolley- having sling bar system-two motion
<b>CO 3</b>	Acquire knowledge Mills, mill components, mill drive & mill setting
<b>CO 4</b>	Acquire skill of Mill setting-Roller setting, pressure feeder setting; underfeed roller setting, chute opening, trash plate setting, and practical optimization of mill setting.
<b>CO 5</b>	Get knowledge about recent advances in Sugar Engineering (Mill house)

**Sugar Manufacturing (Crystallization)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Theory of crystallization & its zones
<b>CO 2</b>	Granting &graining methods
<b>CO 3</b>	Acquire Principals & practices in graining process.
<b>CO 4</b>	Acquire skill Mechanism of pan boiling.
<b>CO 5</b>	Get knowledge about recent Calculations of massecuite %cane &molasses %cane by solid balance

**Subject: Sugar manufacturing (Centrifugal)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> → Centrifugal theories
<b>CO 2</b>	Constructions of batch machine ,types of drive and control → Constructions of continuous machine types of driver and control
<b>CO 3</b>	Acquire knowledge of Centrifugal operations → Screen washing → Sugar washing
<b>CO 4</b>	Acquire skill of <b>Correlation and regression</b>
<b>CO 5</b>	Get knowledge about recent advances (Descriptive statistics)

**DSC-ST 17: DSC-ST 21: Equipment Design (Clarification house)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction to Cane handling and preparation</b>
<b>CO 2</b>	Cane unloading -Bridge with trolley- having sling bar system-two motion
<b>CO 3</b>	Acquire knowledge Mills, mill components, mill drive & mill setting
<b>CO 4</b>	Acquire skill of Mill setting-Roller setting, pressure feeder setting; underfeed roller setting, chute opening, trash plate setting, and practical optimization of mill setting.
<b>CO 5</b>	Get knowledge about recent advances in Sugar Engineering (Mill house)

## Sugar Manufacturing (Crystallization)

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Theory General → Metals, their properties and uses in sugar industries → Different type of metals used in sugar industries. → Metal properties related to engineering/mechanical properties of metal
<b>CO 2</b>	Granting &graining methods
<b>CO 3</b>	Acquire 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>CO 4</b>	Acquire skill Juice Sulphitor → Factors used to design continuous juice Sulphitor or reaction tank. → Lime proportioning device (lime dosing) → SO <sub>2</sub> gas distribution (SO <sub>2</sub> gas dosing) → Mechanical stirrer for mixing of reagent → Design of tank with respect of diameter → Automation for pH control → Construction of continuous juice Sulphitor
<b>CO 5</b>	Get knowledge about recent Sugar Manufacturing (Crystallization)

### Subject: DSC-ST 22: Equipment Design (Evaporation & Crystallization)

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Evaporator → 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>CO 2</b>	Syrup Sulphitor → Factors used to design syrup Sulphitor → Design of syrup Sulphitorwith respective to diameter. → Automation for pH control → Specification and construction of syrup Sulphitor
<b>CO 3</b>	Acquire knowledge of Vacuum Pan → Type of 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>CO 4</b>	Acquire skill of Crystallizers → Type of crystallizers → Horizontal v/s Vertical crystallizers. → Capacity of crystallizer → Various zones and their retention time in cooling process → Quantity of water required for cooling
<b>CO 5</b>	Get knowledge about recent advances : Equipment Design (Evaporation & Crystallization)

**DSC-ST 23: Chemical Engineering-(Heat & Momentum Transfer)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Theory 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
<b>CO 2</b>	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 noncondensable gases.
<b>CO 3</b>	Acquire Heat Transfer Equipment: → Heater- multipass shell and tube type heat exchanger- shell, tubes, tube pitch ligaments' (clearance), tube passes, Baffles.
<b>CO 4</b>	Acquire skill 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.
<b>CO 5</b>	Get knowledge about recent Chemical Engineering-(Heat & Momentum Transfer)

**Subject: DSC-ST 24 Chemical engineering-(Unit operation)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Necessity& mechanism, Rattling's law, kick's law, Bond's law, method of operating crusher, Size reduction in sugar industries
<b>CO 2</b>	Leaching techniques, perforations through solids bed, stationary bed & moving bed. Counter-current leaching, theory of diffusion. Theory of extraction of juice from cane
<b>CO 3</b>	Acquire knowledge of 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 equipment .equipments in sugar industries.
<b>CO 4</b>	Acquire skill of Crystallizers → Type of crystallizers → Horizontal v/s Vertical crystallizers. → Capacity of crystallizer → Various zones and their retention time in cooling process → Quantity of water required for cooling
<b>CO 5</b>	Get knowledge about recent advances : Equipment Design (Evaporation & Crystallization)

**DSC-ST 23: :Capacity Calculation (Clarification house)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Theory 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
<b>CO 2</b>	Capacity of Equipment for process chemical → Calculation of optimum dose of phosphoric acid. → Capacity of lime preparation equipment with lime pumps. → Capacity of Sulphur burner and air compressor.
<b>CO 3</b>	Acquire 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.
<b>CO 4</b>	Acquire skill Juice retention time in different type of clarifier → Capacity of clarifier → Capacity of clear juice pump, capacity of mud pump. Capacity of flash tank,
<b>CO 5</b>	Get knowledge about recent Capacity Calculation (Clarification house)

**Subject: Capacity calculation (Evaporation &Crystallization house)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Capacity of Evaporator → Co-efficient of heat transmit ion, → Quantity of water evaporated, → Properties of steam, → Boiling point elevation.
<b>CO 2</b>	Vacuum pan → Optimum S/V ratio of different pan. → Pan capacity by massecuite %cane method.
<b>CO 3</b>	Acquire knowledge of Centrifugals → Capacity of cooling crystallizers, quantity of water required for cooling → Capacity of centrifugal , Capacity of runoff pump. → Capacity of melter and melt pump
<b>CO 4</b>	Acquire skill of Finishing operation → Capacity of hopper, elevator and grader. → Capacity of hot and cold air blower → Capacity of sugar silo.
<b>CO 5</b>	Get knowledge about recent advances : Equipment Design (Evaporation & Crystallization)

**DSC-ST 23: Chemical Engineering-(Heat & Momentum Transfer)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Theory 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
<b>CO 2</b>	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 noncondensable gases.
<b>CO 3</b>	Acquire Heat Transfer Equipment: → Heater- multipass shell and tube type heat exchanger- shell, tubes, tube pitch ligaments' (clearance), tube passes, Baffles.
<b>CO 4</b>	Acquire skill 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.
<b>CO 5</b>	Get knowledge about recent Chemical Engineering-(Heat & Momentum Transfer)

**Subject: DSC-ST 24 Chemical engineering-(Unit operation)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Necessity & mechanism, Rattling's law, kick's law, Bond's law, method of operating crusher, Size reduction in sugar industries
<b>CO 2</b>	Leaching techniques, perforations through solids bed, stationary bed & moving bed. Counter-current leaching, theory of diffusion. Theory of extraction of juice from cane
<b>CO 3</b>	Acquire knowledge of 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 equipment equipments in sugar industries.
<b>CO 4</b>	Acquire skill of Crystallizers → Type of crystallizers → Horizontal v/s Vertical crystallizers. → Capacity of crystallizer → Various zones and their retention time in cooling process → Quantity of water required for cooling
<b>CO 5</b>	Get knowledge about recent advances : Equipment Design (Evaporation & Crystallization)

**DSC-ST 23: :Capacity Calculation (Clarification house)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Theory 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
<b>CO 2</b>	Capacity of Equipment for process chemical → Calculation of optimum dose of phosphoric acid. → Capacity of lime preparation equipment with lime pumps. → Capacity of Sulphur burner and air compressor.
<b>CO 3</b>	Acquire 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.
<b>CO 4</b>	Acquire skill Juice retention time in different type of clarifier → Capacity of clarifier → Capacity of clear juice pump, capacity of mud pump. Capacity of flash tank,
<b>CO 5</b>	Get knowledge about recent Capacity Calculation (Clarification house)

**Subject: Capacity calculation (Evaporation & Crystallization house)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Capacity of Evaporator → Co-efficient of heat transmit ion, → Quantity of water evaporated, → Properties of steam, → Boiling point elevation.
<b>CO 2</b>	Vacuum pan → Optimum S/V ratio of different pan. → Pan capacity by massequite %cane method.
<b>CO 3</b>	Acquire knowledge of Centrifugals → Capacity of cooling crystallizers, quantity of water required for cooling → Capacity of centrifugal, Capacity of runoff pump. → Capacity of melter and melt pump
<b>CO 4</b>	Acquire skill of Finishing operation → Capacity of hopper, elevator and grader. → Capacity of hot and cold air blower → Capacity of sugar silo.
<b>CO 5</b>	Get knowledge about recent advances : Equipment Design (Evaporation & Crystallization)

**Subject: Chemical Control (Mill house control)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Technical definition → fundamental formula → Differential method for calculation of Brix %Bagasse, fiber %Bagasse, added water % fiberetc → Inferential method for calculation of mixed juice% cane, Bagasse %cane, added water %cane etc. → Clarification of some concepts like java ratio, E.R.Q.V, B.F.C.W.etc
<b>CO 2</b>	→ Primary Extraction → Secondary Extraction → Mill Extraction, reduced mill extraction and whole mill extraction → Control parameters and norms for mill efficiency
<b>CO 3</b>	Acquire knowledge of Centrifugals → Capacity of cooling crystallizers, quantity of water required for cooling → Capacity of centrifugal , Capacity of runoff pump. → Capacity of melter and melt pump
<b>CO 4</b>	Acquire skill of Finishing operation → Capacity of hopper, elevator and grader. → Capacity of hot and cold air blower → Capacity of sugar silo.
<b>CO 5</b>	Get knowledge about recent advances : Chemical Control (Mill house control)

**Subject: Chemical Control (Boiling house control)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Technical definition → Basic formulas for daily manufacturing report
<b>CO 2</b>	Calculation for run report → Pol, Brix, Non-sugar balance → Clarification efficiency & clarification factory. → stocking & available sugar. → Boiling house losses. → Equivalent standard granulated. (ESG)
<b>CO 3</b>	Acquire knowledge of Conversion of raw sugar recovery into white sugar recovery by using ESG formula → Virtual final molasses purity. → Operation including & excluding stoppage.
<b>CO 4</b>	Acquire skill of Recorded boiling house recovery. → Overall recovery → Reduced overall recovery. → Control parameters and norms for efficiency.
<b>CO 5</b>	Get knowledge about recent advances : Chemical Control (Mill house control)



B.Sc. II Semester-IV

**DSC-ST 23: Chemical Engineering-(Heat & Momentum Transfer)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Theory 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.
<b>CO 2</b>	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 noncondensable gases..
<b>CO 3</b>	Acquire Capacity of juice heater → Heater- multipass shell and tube type heat exchanger-shell, tubes, tube pitch ligaments' (clearance), tube passes, Baffles.
<b>CO 4</b>	Acquire skill 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 –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.continuity equation, flow of incompressible fluids. Laminar flow through circularconduit, turbulent flow through pipes, friction factor
<b>CO 5</b>	Get knowledge Chemical Engineering-(Heat & Momentum Transfer)

**Subject: DSC-ST 24 Chemical engineering-(Unit operation)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Size reduction → Necessity& mechanism, Rattling's law, kick's law, Bond's law, method of operating crusher, Size reduction in sugar industries.
<b>CO 2</b>	Vacuum pan → Optimum S/V ratio of different pan. → Pan capacity by massecuite %cane method.
<b>CO 3</b>	Acquire knowledge Leaching techniques, perforations through solids bed, stationary bed & moving bed. Counter-current leaching, theory of diffusion. Theory of extraction of juice from cane
<b>CO 4</b>	Acquire skill of 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 equipment .equipments in sugar industries..
<b>CO 5</b>	Get knowledge about recent advances : Chemical engineering-(Unit operation)

**Subject: DSC-ST 25:Capacity Calculation (Clarification house)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> 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 forso <sub>2</sub> gas d
<b>CO 2</b>	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 forso <sub>2</sub> gas distribution

	system
<b>CO 3</b>	Acquire knowledge of 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>CO 4</b>	Acquire skill of Finishing operation → 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.
<b>CO 5</b>	Get knowledge about recent advances : DSC-ST 25:Capacity Calculation (Clarification house)

### **DSC-ST 26: Capacity calculation (Evaporation &Crystallization house)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Capacity of Evaporator → Co-efficient of heat transmit ion, → Quantity of water evaporated, → Properties of steam, → Boiling point elevation. → 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>CO 2</b>	Optimum S/V ratio of different 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 capacity of injection pump.
<b>CO 3</b>	Acquire knowledge of 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.
<b>CO 4</b>	Acquire skill of 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 efficiency.
<b>CO 5</b>	Get knowledge about recent advances : Capacity calculation (Evaporation &Crystallization house)

### **DSC-ST 27 Chemical Control (Mill house control)**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Technical definition → fundamental formula → Differential method for calculation of Brix %Bagasse, fiber %Bagasse, added water % fiberetc → Inferential method for calculation of mixed juice% cane, Bagasse %cane, added water %cane etc. → Clarification of some concepts like java ratio, E.R.Q.V, B.F.C.W.etc
<b>CO 2</b>	Primary Extraction → Secondary Extraction → Mill Extraction, reduced mill extraction and whole mill extraction → Control parameters and norms for mill efficiency. distribution system
<b>CO 3</b>	Get knowledge about recent advances : Chemical Control (Mill house control) house)

### DSC-ST 28: Chemical Control (Boiling house control)

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Capacity of Evaporator → Co-efficient of heat transmission, → Quantity of water evaporated, → Properties of steam, → Boiling point elevation. → 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>CO 2</b>	Optimum S/V ratio of different 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 capacity of injection pump.
<b>CO 3</b>	Acquire knowledge of 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.
<b>CO 4</b>	Acquire skill of 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 efficiency.
<b>CO 5</b>	Get knowledge about recent advances: Capacity calculation (Evaporation & Crystallization house)

### B.Sc. III Semester-V

### DSC-ST 23: Process Instrumentation & control – I (Mill Section)

At the end of the course, students will be able to -----	
<b>CO 1</b>	Understand Theory Auto cane feed control system Introduction, Need & scope, Classification, Functional elements, Calibration b) Imbibitions water flow rate & temperature control system Introduction, Need & scope, Classification, Functional elements, Calibration c) Central lubricant control system.
<b>CO 2</b>	Introduction, Need & scope, Classification, Functional elements, Calibration d) Mill drive section Thyristor Controlled Variable speed D.C. Drives, Thruster Converter Station (Digital type)
<b>CO 3</b>	Acquire knowledge (Boiler section) a) DCS for boiler control Introduction, need and scope, classification, level measuring instruments, flow measuring instruments, flow diagram
<b>CO 4</b>	Acquire skill Fluid statics- fly ash control system Introduction, need and scope, construction and working, flow diagram. c) Turbine section DCS for turbine control, Introduction, need and scope, Flow diagram, Construction and working, Advantages.
<b>CO 5</b>	Get knowledge Process Instrumentation & control – I

**Subject: Process Instrumentation & Control - II**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> a) Auto pan control system. Introduction, Need & scope, Vacuum control system, Super saturation, control system, Feed control system, Flow diagram , Working.
<b>CO 2</b>	Auto molasses conditioning system Introduction, Need & scope, Brix control system , Temperature control system, Working
<b>CO 3</b>	Acquire knowledge Brix & temperature control system for melter Introduction, Need & scope, Brix control system, Temperature control system, Working
<b>CO 4</b>	Acquire skill of Auto feed control of centrifugal feed. Introduction, Need & scope, Flow control, advantages, Working e) Auto super heated wash system for centrifugal Introduction, Need & scope, Temperature & pressure control, advantages, Working.
<b>CO 5</b>	Get knowledge about recent advances : Instrumentation & Control - II

**Subject: Advance Sugar Technology - I**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> a) Mill Efficiency Various factors affecting milling capacity and efficiency
<b>CO 2</b>	Mill control Auto cane feeding control system for uniform feed rate, Automatic imbibitions water flow and temperature control system, Central lubricant system,
<b>CO 3</b>	Acquire knowledge of New trends in clarification New trend in juice clarification- filtrate and syrup clarification, Advantages of above both processes d) S.R.T diameter.
<b>CO 4</b>	Acquire skill of Pressure feeding system TRPE.GRPF.UFR.
<b>CO 5</b>	Get knowledge about recent advances : Advance Sugar Technology - I

**Advance Sugar Engineering - II**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Capacity of Evaporator → Co-efficient of heat transmit ion, → Quantity of water evaporated, → Properties of steam, → Boiling point elevation. → 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>CO 2</b>	Optimum S/V ratio of different 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 capacity of injection pump.
<b>CO 3</b>	Acquire knowledge of 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.
<b>CO 4</b>	Acquire skill of 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 efficiency.
<b>CO 5</b>	Get knowledge about recent advances : Capacity calculation (Evaporation & Crystallization house)

**B.Sc. III (Sugar Technology) Sem. - VI**  
**Allied Sugar Manufacturing-I**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> a) Manufacturing of raw sugar Clarification process, Crystallization process, Centrifugal process b) Manufacturing of Jaggery & Jaggery powder
<b>CO 2</b>	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
<b>CO 3</b>	Get knowledge about recent advances : Allied Sugar Manufacturing-I

**Allied Sugar Manufacturing-I**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Manufacturing of raw sugar Clarification process, Crystallization process, Centrifugal process
<b>CO 2</b>	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
<b>CO 3</b>	Acquire knowledge of Manufacturing of refine sugar Types of refineries, Mingling and affination process, Clarification of refine melt Evaporation & crystallization, Specification of refine sugar b) Manufacturing of Khandsari sugar Specification of Khandsari sugar, Extraction & clarification of cane juice, Open pan boiling system, Purging, drying & packing system
<b>CO 4</b>	Get knowledge about recent advances : Allied Sugar Manufacturing-I

**Allied Sugar Co – Products -II**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> 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,
<b>CO 2</b>	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
<b>CO 3</b>	Acquire knowledge of 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 .
<b>CO 4</b>	Get knowledge about recent advances : Allied Sugar Co – Products -II

### Water Management in Co-generation Plant-I

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Water Water properties & nature, Source of water, Uses of water & basic chemistry, Water related table
<b>CO 2</b>	Bagasse Composition of bagasse, storage of bagasse, Separation of pith from bagasse, Treatments Filtration, Clarification, Oxidation, Chlorination, De-aeration
<b>CO 3</b>	Acquire knowledge of Ion –exchange method Softner, De-alkalization, Demineralization application & limitation, Resin Membrane technology Ultra filtration, Nano filtration, Reverse osmosis, Electro-dialysis b) 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.
<b>CO 4</b>	Get knowledge about recent advances : Water Management in Co-generation Plant-I

### Water Management in Co-generation Plant-II

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> Cooling tower & cooling water treatments 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 b) Analytical methods & lab equipment's
<b>CO 2</b>	Analysis of Raw water, clarifier water, filter water, soft water, ultra filtration water, R.O. water, D.M. Water & mixed bed water i) Make up and recalculating water
<b>CO 3</b>	Acquire knowledge of Automation and Instrumentation for safety working at Water treatment, Effluent treatment, In plant control method, Environment acts and guide line c) Air pollution Source & control equipments.
<b>CO 4</b>	Get knowledge about recent advances : Water Management in Co-generation Plant-II

### Alcohol Technology - I

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> 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 Definition of Molasses, Total reducing sugar, Fermentable/Unfermentable
<b>CO 2</b>	Wort, Brix, Specific gravity, Distillation, Industrial alcohol, Proof spirit, Strength of \spirit, Reflux, Vaporization, Saccharification, Scaling, Scrubber, Starch, sucrose, Rectification, Gelatinization, liquefaction, Re-boiler
<b>CO 3</b>	Acquire knowledge of 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.

<b>CO 4</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
<b>CO 5</b>	Get knowledge about recent advances : Alcohol Technology – I

### **Alcohol Technology – II**

At the end of the course, students will be able to -----	
<b>CO 1</b>	<b>Introduction:</b> 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>CO 2</b>	Distillation equipments Columns, design & construction, maintenance, Types of trays, Types of condenser, Types of Re-boilers
<b>CO 3</b>	Acquire knowledge of Effluent treatment system in Distillery, Quality of effluent, IS specification of effluent, Biological treatments, Aerobic treatments, Anaerobic treatments.
<b>CO 4</b>	Get knowledge about recent advances : Alcohol Technology – II