SYLLABUS

ASSOCIATESHIP COURSE IN SUGAR TECHNOLOGY FIRST YEAR A.N.S.I. (S.T.)

SUBJECT: ORGANIC CHEMISTRY (THEORY)

CODE: ST/101 MAX. MARKS: 50

1. Structure, Bonding & Stereochemistry of organic compounds

Introduction to organic compounds and its classification, modern concept of boding, Hydrogen Bond, General idea about various reactions, Electron displacement effects: Inductive, Electrometric and Resonance effects, Stereoisomerism with reference to optical and geometrical isomerism. Enantiomers, diastereomers, racemic modifications & meso-isomers. Cause of optical activity. Chirality and R/S configuration. Cis-Trans and E-Z isomers & Geometrical isomerism in cyclic compounds. Stereochemistry and cyclic forms of sugars.

2. Carbohydrates.

Introduction and Classification of Carbohydrates with suitable examples-

a. Monosaccharides- properties and reactions of monosaccharides (taking Glucose/levulose as example) such as Mutarotation, Alkaline degradation, Rearrangements & isomerization, Acidic degradation, Polymerisation, Caramelisation, Interconversions of monosaccharides.

b. Di and Oligosaccharides-nomenclature and general methods for determination of their structures. Preparation /isolation and structural studies of Maltose, Cellobiose, Lactose, Sucrose and Raffinose.

c. Polysaccharides – 1- Classification. Structural studies and uses of Cellulose and Starch. Effect of Starch on cane juice processing during sugar manufacture and its removal. 2- Dextran-Its structure and formation in Sucrose containing media, including cane juice. Effect of dextran on sugarcane juice processing and removal. Analysis of dextran in sugar/sugar house products.

3. Colour Constituents: Nature of various colouring constituents present in sugarcane juice and their role in the development of colour in sugar house products. Methods of elimination of colouring constituents during processing.

4. Non-nitrogenous Acids, Amino acids, Proteins & Quaternary ammonium compounds, Nature of non-nitrogenous organic acids present in sugarcane juice and their effect on the process of sugar manufacture. Classification, general properties and chemical reactions of amino acids. Maillard reaction. Major amino acids present in sugarcane juice. Role of amino acids in the process of sugar manufacture. Proteins: Characteristics, classifications of proteins, protein structure, proteins in sugarcane juice. An introduction to quaternary ammonium compounds.

5. By-Products diversification:

Sugarcane product diversification: Potential & future challenges, Synthesis, isolation, properties and uses of end products derived from bagasse, pressmud & molasses such as Furfural from bagasse, Sugarcane wax from pressmud and Aconitic acid from molasses.

6. Alternative Sweetners: Sugar Substitute-Structure and properties (including sweetness) of following sweeteners- Saccharin, Neotame, Cyclamate, Aspartame, Stevioside and Sucralose & Sucrononic Acid. Sugar Alcohol (Sorbitol, Mannitol and xylitol).

Reference Books—

1. Organic Chemistry by R.T.Morrison & R.N.Boyd, (2008) 6th Edition,
2. Organic Chemistry by I.L.Finar, Vol.II & Vol.II, 7th Edition, Reprint (2009)
3. Cane Sugar Handbook by J.C.P.Chen,(1985) IInd Edition
4. Principles of Sugar Technology Vol. I by Pieter Honig
5. Sweeteners and Sugar Alternatives in Food Technology, Second Edition by Dr Kay O'Donnell, Dr Malcolm W. Kearsley

SUBJECT: PHYSICAL CHEMISTRY (THEORY)

CODE: ST/102 **MAX. MARKS: 50**

1. Analytical Chemistry: Mole, Normality, Molarity, Molality, Formality, ppm, ppb, ppt, Mole fraction, Equivalent weight and Numerical based on it.
2. Basic concepts of measurement of electrical conductivity.Strong and weak electrolytes, Specific conductivity, Molar conductivity, Equivalent conductivity. Application of conductance measurement, Determination of conductivity ash by ICUMSA method, Physico chemical characteristics of precipitation in clarification process in sugar manufacture.
3. Acids and Bases; Arrhenius concept, Proton transfer theory, Lewis concept, Dissociation of weak acids. The pH Scale, pH measurement using Hydrogen electrode, Glass electrode, Buffer mixture of weak acid and its salts. Calculation of pH values of buffer mixtures. Henderson's equation.
4. Crystallization : Difference between crystalline and amorphous solids. law of crystallography Space lattice and unit cell, Bravias lattices, Seven crystal systems. Point defects; Schottky defects, Frenkel defects. Influence of non sugars present in sugar house products on the rate of crystallization and shape of crystals.
5. Types of colloidal Systems, classification of colloids, Lyophobic and lyophilic sol, size, range, properties of colloidal systems, Electrical properties, charge on colloidal particles, Coagulation of colloidal solutions. Colloids in cane juice, elimination of colloids in clarification process of sugar manufacture, coagulants and their role. Turbidity: Concept of turbidity, reason for appearance of turbidity, Method for determination by turbidity meter.
6. Adsorption; Difference between adsorption and absorption, Adsorbent, Adsorbate Chemisorption and Physisorption, positive and negative adsorption, Factors influencing Adsorption.
7. Colorimeters and spectrophotometers-their principle, working diagrams, Beer-Lambert's law and its derivation, λ_{max} and factors affecting λ_{max}, Colour and its measurement. Factors affecting the colour measurement. Measurement of colour of sugar solution by GS-8, GS-9, GS-10 ICUMSA methods.
8. Surface tension, Surface energy, measurement of Surface tension, effect of temp on surface tension, Surface active agents (Surfactants), Viscosity, Determination of Viscosity, Effect of temperature on viscosity.

Reference Books—

1.Principles of Physical Chemistry By Puri, Sharma & Pathania, Nagin Chand & Co., New Delhi

2. Physical Chemistry By Peter at kins , Oxford Publishing House

3. Physical Chemistry by K.L. Kapoor, Mackmillan Publication.

SUBJECT: BIOCHEMISTRY (THEORY)

CODE: ST/103 **MAX. MARKS : 50**

1. Introduction: Molecular basis of living organisms.
2. Structure of cell and sub cellular organelles and their functions, e.g., nucleus, mitochondria, endoplasmic reticulum, cell membrane, cell wall, ribosomes, etc.
3. Carbohydrates: Outline of structure and functions of carbohydrates found in living organisms. Metabolism of carbohydrates including glucolysis, HMP, TCA cycle and Electron transport chain, Pasteur effect.
4. Proteins: outline of structure of common amino acids present in proteins and their properties. Transamination , deamination and decarboxylation of amino acids. Common properties of proteins & isolation of a single protein from cell free homogenate.
5. Nucleic acids: Outline of structure and functions of nucletides, RNA & DNA, Watson Crick model of DNA structure, Tm value. Replication, transcription and translation process.
6. Lipids: outline of structure and functions of fatty acids, phospholipids & steroids, oxidation of fatty acids.
7. Vitamins: Occurrence, structure, function & coenzyme function of vitamins.
8. Enzymes – nomenclature, properties, kinetics and types of enzymes.
9. Photosynthesis – Energetic of photosynthesis, Z-scheme, photophosphorlation calvin cycle and C_4 pathway.
10. Control of microorganisms in sugar factory .
11. Industrial Waste Treatment–treatment of sugar factory effluent.Primary & secondary methods of effluent treatment, measures to reduce volume and load of effluents by good house keeping and their reuse.
12. CPCB norms/or land air & water pollution/or sugar and distillery.
13. Air pollution control devices & boiler of sugar factory.

Reference Books—1. Principles of Biochemistry by A. L. Lehninger , CBS Publishers,Delhi
2. Text Book of Biochemistry by E. R. West W. R.Todd, The Macmillan Company, New York ,U.S.A.

SUBJECT: SUGARCANE AGRICULTURE (THEORY)

CODE: ST/104 **MAX. MARKS: 50**

1. Sugar Producing Plants.
2. History, Origin and Distribution of Sugarcane, Major Sugarcane producing countries in the world. Area under sugarcane cultivation in different states in India.
3. Soils: Definition, weathering and soil formation, Composition and classification of Indian Soils.
4. Cultivation of sugarcane, preparation of land, periods of sowing, cane seed, methods of planting, irrigation, and optimum conditions for germination, tillering, growth and maturity of the crop, water management in sugarcane crop.
5. Nutrition of sugarcane: Nitrogen, Phosphorous and Potash, effect of each element on tonnage and sugar content. Role of micronutrients in sugarcane.
6. Major diseases and pests of sugarcane and their integrated control measures.
7. Harvesting and transport management: Methods of testing maturity in sugarcane, methods of harvesting and transport of sugarcane. Measures to control harvesting and transport in order to supply fresh and mature cane to sugar factory.
8. Sugarcane varieties : Short introduction to the methods to evolve new varieties including their selection. Major sugar cane varieties of different states.

9. Sugar beet: Importance of sugar beet in sugar production in the world, brief idea on cultivation of sugar beet including time of sowing, fertilizers and irrigation and its comparison with sugarcane.
10. Rice: Recommended varieties in India and seed rate, time and method of sowing, irrigation, fertilizer use, control of weeds, insect-pests and diseases, harvesting, processing and yield.
11. Maize: Recommended varieties in India and seed rate, time and method of sowing, irrigation, fertilizer use, control of weeds, insect-pests and diseases, harvesting, processing and yield.

Reference Books—1. Agriculture of the Sugarcane by A. C. Barnes, Leonard Hill Ltd.U.K.
2. Hand Book of Agriculture by J.D. Jameson, I.C.A.R., New Delhi

SUBJECT: STATISTICS

CODE: ST/105 **MAX. MARKS: 50**

1. Definition, scope, collection, classification of primary data. Frequency distribution and graphical representation.
2. Measures of Central Tendency, Dispersion and Skewness, Kurtosis.
3. Interpolation and extrapolation (only Newton's forward and backward formula and Lagranges formula).
4. Correlation coefficient, total, partial, multiple for three variables only (Elementary knowledge of subject with emphasis on the applied side by solving numerical problems), Regression equation, coefficient, curve fitting by method of least squares, standard error.
5. Testing of hypothesis, tests of significance of means and correlation coefficient (excluding paired 'T' test). Normal distribution, Z-distribution, fitting of normal curve (without the use of calculating machine), chi-squares goodness of fit test.
6. Association of attributes, significance by chi-squares, theory of attributes, Contingency table.
7. Sugar Statistics, data on production, consumption, imports, exports, stocks and price of sugar and sugarcane at all India and state level ; import & export of sugar machinery, its prices and other related statistics.

Reference Books—1. Fundamentals of Applied Statistics by S. C. Gupta S.Chand&Co.
2. Statistical Methods by S. P. Gupta Pub.S. Chand & Co. N.Delhi

SUBJECT: ENGINEERING

CODE: ST/106A **MAX. MARKS: 80**

A. MECHANICAL ENGINEERING

1. **Basic Concepts & laws of thermodynamics**
Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic view points, Thermodynamic Equilibrium, State, Property, Process, Cyclic Process & Quasi – static Process, Energy and its forms, Work and heat (sign convention), Polytropic law, Zeroth law of thermodynamics: First law of thermodynamics, Limitations of first law of thermodynamics, PMM-I. Second law of thermodynamics: Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements.

2. **Properties of steam**
Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Dry, Saturated & Superheated steam, Phase transformation process of water, T-S and H-S diagrams, Use of property diagram, Steam-Table Calculations & Mollier chart, Dryness factor and its measurement.

3. **Fuels & Combustion**
Introduction to solid, liquid and gaseous fuels– Stoichiometry, Combustion analysis, Products of

combustion, Exhaust gas analysis, Heating values, Air requirement, Air/Fuel ratio, Calorific value of fuels.

Reference Books—1. Thermal Engineering by R.S. Khurmi, S. Chand &Co. , New Delhi

B. ELECTRICAL ENGINEERING

1. **DC Motor:** Principle of operation of DC motor, Construction features of DC motor, Classification of DC motors, Electromagnetic torque equation of DC motor, Losses in DC motor, Staring/ Braking of DC motor, Speed control of DC motors, Applications of DC motor.
2. **DC Generator:** Principle of operation of DC generator, Construction features of DC generator, Classification of DC generators, EMF equation of DC generator, Losses in DC generator, Parallel operating conditions of DC generator.
3. **Transformer:** Principle of operation of transformer, Construction features of transformer, EMF equation of transformer, Classification of transformers, Losses in transformer, Transformer efficiency, OC & SC tests of transformer, Transformer taps, Parallel operating conditions of transformer, Auto transformer, Instrument transformer, Applications of transformer.
4. Direct & Alternating current, Basics of R/L/C circuits, Vector diagrams, Electrical resonance, Active/ Reactive/ Apparent powers, Three phase star and delta connections.

Reference Books-

1. A Text Book of Electrical Technology by B.L. Theraja
2. Fundamental of Electric Machines by B.R. Gupta & Vandana Singhal

SUBJECT: INSTRUMENTATION

CODE: ST/106B **MAX. MARKS: 20**

1. Terminology: Terms associated with Instrument Technology like accuracy, precision, calibration etc.
2. Pressure: Definition, different types of pressure like Gauge Pressure, Atmospheric Pressure and Absolute pressure, relation between them. Units of pressure, measurement of pressure, Pressure Transmitters.
3. Vacuum: Definition, measurement of vacuum-by-vacuum gauge and U tube manometer.
4. Elastic devices: Bourdon tube, Diaphragm and Bellows, construction and working of a 'C' type Bourdon tube pressure gauge, construction and working of vacuum gauges, its error and methods for removal, calibration procedure. Application of Diaphragm and Bellows.
5. Measurement of Temperature: Filled system thermometer: gas filled, vapour pressure filled and liquid filled thermometer. Construction and working of gas filled, vapour pressure filled and liquid filled thermometer. Its merits and demerits and range of application. Resistance thermometer: Elements, construction, working theory and application. Thermocouple: Definition, different types, ranges, construction, working theory and application. Pyrometer: Definition, different types, construction, working theory and application.
6. Measurement of flow: Orifice Plate, flow measurement with the help of orifice plate. Accuracy and area of application. Rota meter: construction, working theory, accuracy and application.
   Electromagnetic Flow meter: Working principle, construction, maintenance, area of application.
7. Measurement of level: Sight gauge glass, counted weight type, air purge type, Buoyam type
8. Measurement of pH: Construction of electrodes, maintenance of electrodes, circuit diagram. Measurement of Conductivity.
9. Boiler Instrumentation:
   Pressure measurement of steam, use of pig tail siphon for such measurement.
   Flow measurement of steam by orifice plate and differential pressure transmitter. Use of

condensate pot for such measurement.

Boiler drum level measurement by sight gauge glass method.

Draught gauges. Flue gas temperature, steam temperature, boiler feed water temperaturemeasurement by Thermocouple. On line Oxygen Analyser.

Reference Books—1. Instrument Technology, Vol.1-4 by E.B. Jones, English Language Book Society, Butter worth's U.K.

2. Instuement Engineer's Hand Book by Considine, Butterworth Heinemann Ltd. U.K.

1. Industrial Instrumentation & Control by S.K. Singh Tata McGraw Hill Publication.

SUBJECT: CHEMICAL ENGINEERING

CODE: ST/ 107 MAX. MARKS: 50

1. **Basic Concept**'s
   (a) Study of the basic concepts of chemical engineering unit process and unit operations.
   (b) Unit operations and stoichiometry and material balance in process in sugar manufacture.

2. **Fluid Mechanics**
   (a) Classification of fluids and fluid flow phenomena. Newtonian and non Newtonian fluids, Laminar, turbulent, steady and uniform flow.
   (b) Pipeline flow. Bernoulli's equation- Friction losses and pressure drop in pipelines.
   (c) Transportation of fluids- Classifications of pumps-Power requirement, Head, capacity, and NPSH for pumps.
   (d) Mixing and agitation- Types of mixing equipment.
   (e) Application of fluid mechanics in Sugar Manufacture.

3. **Heat Transfer & Evaporation**
   (a) Heat transfer without change of phase- conduction and convection.
   (b) Heat transfer by change of phase- Mechanism of boiling and condensation. Effect of Non condensable gases on condensation.
   (c) Heat transfer equipment- Single pass and multipass heat exchangers. Regenerative, recuperative and direct contact exchangers.
   (d) Evaporation practice in the sugar industry-single and multiple effects including RF & FF evaporator. Factors affecting evaporation – boiling point elevation, hydrostatic head, tube length and design.

4. Introduction to corrosion engineering:-
   a. Classification of engineering materials.
   b. Mechanical properties of material stress, strain, elastic & plastic deformation.
   c. Failure of material – Fracture, Fatigue & Creep.
   d. Corrosion & its control.
   e. Material of construction in Sugar Industry.

Reference Books—1. Introduction to Chemical Engineering by Badger & Banchero, Mc Graw Hill Book Book Co. Auckland

2.Unit Operation of Chemical Engineering by W.L. Mcab & J.C. Smith ,Mc Graw Hill Book Co.,Newyork

3. Material & Process by young.

4. Handbook of Corrosion Engineering- Pierre R. Roberge McGraw-Hill Publishing (2000)

5. Transport Presses and separation Process Principles Chiristie John Geanboplis (PHI)

6. Heat Transfer: Principle and Applications by B.K. Dutta PHI Learning.

7.Introduction to Chemical Engineering by Tata Mchnaw-Hill Publishing- by S K Ghosal, S K Sanyal, SD Datta

SUBJECT: SUGAR TECHNOLOGY (THEORY)

CODE: ST/ 108 **MAX. MARKS: 50**

CHEMICAL CONTROL

Mill house control, technical definitions, fundamental formulae for cane, added water, mixed juice and bagasse, calculation of brix% bagasse, fibre% bagasse, fibre percent cane, undiluted juice lost in bagasse percent mixed juice, added water extracted in mixed juice percent added water in cane, concept of refractometric brix, true purity.

Methods of control, differential and inferential methods. Primary extraction, secondary extraction using simple and compound imbibition schemes. Ideal extraction, mill extraction, brix curves. Brix free cane water, juice lost percent fibre, Reduced Mill Extraction by Deer's and Mittal's Formulae.

JAVA SYSTEM OF CHEMICAL CONTROL

Inferential Methods of calculations of bagasse percent cane, mixed juice percent cane, brix percent cane, diluted juice percent cane, undiluted juice in mixed juice percent cane, added water percent cane and calculation of wt. of cane. Mathematical formula for bagasse per unit cane and added water per unit cane. Methods of comparison of milling efficiency of factories. A case study with D.M.R. related to mill house control.

GENERAL IDEA OF SUGARCANE PLANT AND SUGAR MANUFACTURING

The occurrence of sugars, sugars of commercial significance, different types of cane sugar factories, different types of sugar manufactured, classification of sugar factories according to process used, product turned out and from point of view of operation.

Various unit operations of cane sugar factories in brief with special emphasis on juice extraction from cane. Maceration/imbibition, relative merits and demerits of cold and hot water imbibition/maceration, maceration/ imbibition schemes, role of sanitation in sugar manufacture with emphasis on mill sanitation, ERQV.

CLARIFICATION

Composition of sugar cane and juice, various constituents of cane and their properties. Object of clarification, nature of cane juice clarification, chemical reagents used in clarification, action of lime on different constituents of juice. Action of heat on different constituents of juice, action of lime on heated juice, behavior of sugar- lime- water system. Inversion/decomposition of juice in the process with respect to temperature & pH.

Introduction of different processes of clarification, historical development of Defecation and introductory idea about Double Sulphitation Process, precipitation of impurities & flocculation, and role of inorganic and organic phosphates, compound clarification and saccharate liming.

CLARIFICATION EQUIPMENTS

Different types of equipments to remove suspended impurities from juice viz. vibrating type, fixed type e.g. DSM & rotary juice screens, hot juice screening, measurement/Weighment of juice- measuring tanks, weighing(Maxwell bolougue type, beam scale etc.) online Weighment, Juice flow stabilization system.

Juice heaters - different type of juice heaters, utilization of juice heaters to achieve steam economy, V.L.J.H., dynamic juice heaters, direct contact juice heaters & condensate heaters, plate type juice heater, juice heater mountings, milk of lime preparation, slaking and grit removal system, composition of milk of lime, different types of filtration systems for filtration of muddy juice in cane sugar factories e. g. Plate & Frame type fitter presses, Rotary vacuum Filters & Decanters etc. Process parameters & their role in clarification. General idea for filtrate & s syrup clarification.

Reference Books—1. Principles of Sugar Technology Vol.1-3 by Peter Honig, Elsvier Pub. Co., Newyork, 2. Training manual for Sugar Mills by Mangal Singh ,Somaiya, Pub. Pvt. Ltd. Mumbai

SUBJECT: DRAWING & DESIGN

CODE: ST/109 **MAX. MARKS: 100**

THEORY

1. **FUNDAMENTALS OF ENGINEERING DRAWING** : Conventional lines – Description of conventional lines. Orthographic projection, first and third angle projection, plane of projection, orientation of object. Reading of different scales and their uses. Dimensioning rules. Section and their conventions. Symbols of different materials.

2. **FASTENERS**: Classification of fasteners ,temporary fasteners , permanent fasteners.
   Temporary fasteners : Nut and bolts, screws keys, cotters and pins, different types of threads & their properties, kinds of washers and their uses.
   Permanent fasteners : Welding, soldering and Brazing. Welding – Types of welding, types of welding joints, welding symbols and their standard location.

3. **COUPLINGS:**
   Classification of couplings – Rigid flange coupling, flexible coupling, universal coupling, claw clutch coupling, their uses and properties. Design proportion of main components.

4. **BEARINGS AND BRACKETS: Use** of bearing, types of bearings: Bush bearing, Ball & roller bearing, Foot step bearing, Journal bearing, Thrust bearing, their main properties and proportions, Plummer blocks, & uses of brackets.

5. Fundamentals of Computer Aided Drafting.

ASSIGNMENTS-

1- Practice on Computer Aided Drafting in Auto CAD Lab.

ASSIGNMENTS

1. FUNDAMENTALS OF ENGINEERING DRAWING:

(i) Depiction of orthographic projection showing the method of drawing views with respect to Ist angle projection and 3rd angle projection.

(ii) With the help of orthographic projection drawing of different sectional views.

(iii). Drawing of different views from given isometric projection and determination of additional views from the given views and sectional views from the isometric view

2. FASTENERS:

i. Different types of nut and bolt assembly, studs washers.
ii. Different types of keys, cotters and cotter joints.
iii. All types of threads with angle, pitch and depth.
iv. Different types of welding and welding symbols.

3. SHAFT COUPLINGS: Rigid flange coupling, non rigid or flexible coupling.

4. SHAFT BEARINGS AND BRACKETS:

i. Bush bearing ii. Foot-step bearing
iii. Plummer block iv. Wall brackets.

Reference Books— Computer Aided Degines in Mechanical Engineering by V. Ramamurthy,Tata Mc Graw Hill, New Delhi
2- Machine Drawing by P.S. Gill

SUBJECT: ORGANIC CHEMISTRY (PRACTICAL)

CODE: ST/110 **MAX. MARKS: 50**

1. sugar Qualitative analysis of sugars (Mono & Disaccharides) and preparation of their osazone derivatives.
2. Quantitative analysis of Dextran of following using spectrophotometric methods
   a. Determination of Dextran in sugar and sugar house products.
   b. Determination of Starch content in sugar and sugar house products.
   c. Determination of Polyphenol in cane juice and plantation white sugar.
   d. Determination of Amino acid content in cane juice and plantation white.

SUBJECT: PHYSICAL CHEMISTRY (PRACTICAL)

CODE:ST/111 **MAX. MARKS: 50**

1. Find the Surface Tension of given solution at room temperature and report its value in proper unit.
2. Prepare sugar solution of different composition and find the Surface Tension value at room temperature. Plot a graph between %age composition and Surface tension. Report the %age composition of unknown sugar solution.
3. Find the Viscosity of given solution at room temperature and report its value in proper unit.
4. Prepare four sugar solutions of different composition, Find the Viscosity at room temperature. Plot a graph between %age composition and Viscosity and report the %age composition of unknown sugar solution.
5. Study the adsorption of oxalic acid on different samples of charcoal each and report the value of 'k' and 'n' using NaOH solution.
6. Find the color of sugar sample in solution phase by GS-8, GS-9, GS-10 and report the value of color in ICUMSA unit (IU).
7. Find the λ_{max} of colored solution and report the values in proper units.
8. Determination of conductivity ash of sugar by ICUMSA method.

SUBJECT: BIOCHEMISTRY (PRACTICAL)

CODE: ST/112 **MAX. MARKS: 50**

1. Microscopic examination of bacteria, yeasts, and moulds.
2. Preparation of bacterial cultures on slides and their staining .
3. Effluent analysis:
   a) Determination of Oxygen Absorption (OA) value.
   b) Determination of Chemical Oxygen Demand (COD) value by colorimatery.
   c) Determination of Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD) Value.
   d) Determination of Nitrite content.
4. Analysis of molasses for Total Reducing Sugars (TRS)
5. Determination of amino nitrogen content.
6. Counting of living and dead yeast cells by hemocytometer.
7. Principles and operation of instruments used in a biochemical laboratory (Demonstration Experiment).

SUBJECT: SUGAR CHEMISTRY (PRACTICAL)

CODE: ST/113 **MAX. MARKS: 50**

Volumetric and gravimetric analysis of:

1. Calcium as CaO and $CaCO_3$. 2. Phosphate as P_2O_5.
3. Sulphate as SO_4 4. Determination of maturity of sugarcane using cane puncturing needle & hand refractometer.
5. Determination in pol in cane and Fiber percent in cane. 6.Calculate the Extraneous matter in cane.
7. Determination in Titrable acidity in cane juice.

SUBJECT: SUGAR TECHNOLOGY (PRACTICAL)

CODE : ST/ 114 **MAX. MARKS : 50**

1. Determination of total dissolved solids by:
   (a) Brix spindle, (b) Refracto-meter
2. Determinations of pol and calculation of apparent purity in juices, syrups, massecuites, molasses and other boiling house products.
3. Determination of sucrose and calculation of gravity purity by Jackson and Gills method in juices, syrups, massecuites, molasses and other boiling house products.
4. Determination of reducing sugars in juices, syrups, massecuites, molasses, sugars and other boiling house products by:
   (a) Lane and Eynon method (b) Lane and Eynon (constant volume method)
5. Determination of CaO content in juices, syrups massecuites, molasses and other boiling house products by E.D.T.A method.
6. Determination of phosphate content in juices by
   (a)Ammonium molybdate method (b) Colorimetric method
7. Determination of pH of various boiling house products by
   (a) pH indicator papers (b) Digital electronic pH meters
8. Analysis of bagasse for moisture% and pol%
9. Analysis of Press mud/filter cake for moisture% & pol%

Reference Books— System of Technical Control by N.C. Verma ,S.T.A.I.,New Delhi

ASSOCIATESHIP COURSE IN SUGAR TECHNOLOGY
SECOND YEAR

SUBJECT : SUGAR CHEMISTRY (THEORY)

CODE: ST/201 **MAX. MARKS : 50**

1. General Principles of Technical Sugar Analysis

A. Principle and Statistical methods of sampling, Sampling techniques for sugarcane, bagasse, juices, press cake, molasses, sugar and other sugar house products.

B. Moisture determination in bagasse, molasses, sugar and other sugar house products.

C. Different types of solids present in cane juice, various methods of solid determination, Viz-

(a) Densimetric methods of analysis

i) Solution factor. ii) Specific gravity of impure sugar solution.
iii) Methods of determination of specific gravity.

(a) Specific gravity bottles.
(b) Displacement methods of specific gravity, determination westphal balance, displacement method, hydrometers, sweet water spindle, Baume hydrometer.

iv) Relation between Brix and dry substance.

(b) Refractometric method of solid determination

i) Principle of refraction. ii) Refractometric trough

iii) Single Prism refractometers. iv) Double prism or ABBE referactometers.

D. Optical methods of sugar analysis

Principles of polarimetry-polarized light, specific rotation of sugars and various factors affecting specific rotation, polarization by nicol prism, principles of polarimeter and saccharimeter, sugar scales and normal weight, methods of simple polarization. ICUMSA method for polarization of raw sugars , juice, syrups, molasses, massecuites etc. Error due to the use of lead sub-acetate and methods for its elimination, methods of double or invert polarization of impure sugar solutions such as molasses, syrups, massecuites etc.

E. Estimation of reducing sugars

Principles of reduction of copper and other metals by reducing sugars, use of chemicals for complexing copper, classification of different methods-their advantage and disadvantage. Lane and Eynon method for estimation of reducing sugars and its modification. Luff & schoorl method for determination of reducing sugars; determination of sucrose by titration method and after destruction of reducing sugars.

F. Boiler feed water

Various sources, impurities present in water, methods of analysis, various processes for making water fit for feed and the specifications of feed water for different pressure boilers.

G. Method of estimation of various constituents in cane and cane Juice. viz Pol % Cane by direct & inferential method, fibre % cane directly, P_2O_5, CaO content in cane juice.

Reference Books—1. Analytical Agriculture Chemistry by S.L. Chopra,Kalyani Publishers, New Delhi

2.Hand Book of Cane Sugar Technology by R.B.L. Mathur , Oxford Publishing Co. ,New Delhi

SUBJECT: STATISTICAL QUALITY CONTROL

CODE: ST/202A MAX. MARKS: 30

Definition and uses of statistical quality control. Product control, Process control and control limits. Statement of SQC limits for X-Chart, R-Chart, p-Chart and c-Chart.

Simple numerical exercise based on X,R ,p and c-Charts.

Reference Books— Fundamental of Applied Statistics by S.C. Gupta ,S. Chand & Co New Delhi

SUBJECT: BY PRODUCTS

CODE: ST/202B MAX. MARKS : 20

1.BAGASSE :Characteristics of bagasse, , production of furfural, production of biogas & bio-manure, production of pulp, paper, and different boards. Use of bagasse for cattle feed, use of bagasse for production of ethanol (cellulose ethanol).

2.PRESSMUD: Characteristics of pressmud, extraction of cane wax - its purification & bleaching,use of sulphitation pressmud as manure, production of biogas & biomanure from pressmud.Use for making biocompost in distillery.

Reference Books— By Products of Cane Sugar Industry
by J.M. Paturau ,Elsevier Pub. Co. U.S.A.

SUBJECT: CHEMICAL ENGINEERING

CODE: ST/203 **MAX. MARKS : 100**

1. Introduction to solid-solid and solid liquid separation

Fluid solid separation – cyclones and hydro clones. Separations based on adsorption- Ion exchange separation

Membrane separation processes- ultra filtration and reverse osmosis.

Solid Solid separation – Screening- screen effectiveness & screen analysis.

2. Filtration

Introduction- Constant pressure and constant rate filtration. Compressible and non-compressible cake. Filtration practice in sugar industry and Plate Frame, rotary vacuum, deep bed filter and centrifugal filtration.

3. Sedimentation

1. Settling phenomena.
2. Stokes and Newton's Law of settling.
3. Free, hindered, batch and continuous settling, centrifugal sedimentation.
4. Application of settling to sugar industry practice. Batch, Continuous and Short retention clarifiers.

Reference Books—1. Introduction to Chemical Engineering by Badger & Banchero, Mc Graw Book Co.,Auckland for both books

2. Unit Operation of Chemical Engineering by W.L. Mcab & J.C. Smith

3. Chemical Engineering Vol I & II by coulson & Richerdson

4. Transport Process and separation Process Principles by christie Joha Geanboplis (PHI)

5. Introduction to Chemical Engineering by Ghosal/ Sanyal/ Datta (Tata McGraw- Hill)

SUBJECT: BUSINESS MANAGEMENT

CODE: ST/204 **MAX. MARKS: 50**

1. Nature and scope of management, Fundamental principles, Definition, Process of management functions(Definition of management, Concept, Fayal's Principles and Taylors Principles).
2. Planning- Definition, Importance, type organizing- concept, type of organization, Delegation of authority.
3. Staffing- Definition, importance, functions, Recruitment, selection.
4. Controlling process, type of control. Dissecting-definition, process, advantages.
5. Motivation-concept, impotence, types (Maslow's Theory and Theory X & Theory Y) Leadership- Definition, Trail theory, characteristics of leadership.
6. Personnel Administration: Personnel Department its functions, labour incentives, recruitment types, selection procedure.(HRM, Human Resource, Planning- Objectives & Process, Recruitment and Selection)
7. Factory act affecting industrial undertakings and workers in the factory

Safety and health provisions, industrial hazards (The Sugar Industry of India, The sugarcane Act, 1934, & The Factories Act 1948).

Reference Books— Industrial Organization & Management by Lawrence L Bethel, Mc Graw Hill Book Co. New york

SUBJECT : SUGAR TECHNOLOGY (MANUFACTURE-I)

CODE: ST/205 **MAX. MARKS: 75**

CLARIFICATION:-

Origin & Development of Sulphitation Process, preparation of reagents & fundamental Reaction, precipitation of Non-sugars upon Liming & Sulphitation of Cane Juice, production of sulphur dioxide in batch's & continuous furnaces (film type & prol type), properties of Sulphur dioxide, precipitation & solubility of calcium sulphite, effect of purification, mixing & circulation in Sulphitation tanks. Distribution of SO_2 & milk of lime, manner of precipitation & filterability, Continuous Sulphitation.

Introductory idea of Carbonation Process, Comparison of Sulphitation & Carbonation Process. Single Carbonation, Defecation, Double Carbonation & Double Sulphitation Process; Modified Dehaan's Process. Process of vacuum filtrate clarification, advantage & disadvantage of sulphitation process.

EVAPORATION

Principles of evaporation, Rillieux Principles, Study & Operation of Multiple Effect Evaporators. Vapour Cell, Pre-evaporator, Vapour Bleeding Systems, Catch-alls, scale formation & their removal, factors affecting efficiency of evaporation, removal of condensate and incondensable gasses, cause of entrainment, different devices to prevent entrainment, effects of entrainment.

Long tube film type evaporators, Comparison of conventional & film type evaporators. Different types of bleeding systems for steam saving bodies with Quadruple & Quintuple arrangement. Recent advances in chemical cleaning, anti-scalent compounds, hydro jet cleaning, low temperature evaporator module.

Reference Books—1. Principles of Sugar Technology Vol.1-3 by Peter Honig, Elsevier Publishing Co. Inc.

2.Cane Sugar Manufacture in India by D.P. Kulkarni , S.T.A.I.NDelhi

SUBJECT: SUGAR TECHNOLOGY (MANUFACTURE-II)

CODE: ST/206 **MAX. MARKS: 75**

PAN BOILING

Glossary of the terms used in Pan Boiling: Concept of Saturation & Super-saturation. Solubility Coefficient & Super-saturation Coefficient. Classens theory of Pan boiling. Super-saturation & Crystal formation, Crystal growth, Conglomerates, False grain, Factors affecting rate of Crystallization, Crystal size and crystal surface area, Measurement of Super-saturation during boiling (Refractive index, B.P.E., Electrical conductivity, Heat transmission).

Type of vacuum pan, batch & continuous including horizontal & vertical continuous pan, Different types of calendrias, Effect of hydrostatic head & circulation in Pan-boiling. Calculation of heating surface of Pans, Steam consumption, Operation of Sugar boiling Process (concentration, graining, building up the grains, tightening the massecuite), Molasses conditioning. Boiling control instruments, Crystal content of massecuite, Gillett's concept of low grade boiling.

CRYSTALLIZATION

Crystallization in motion & in rest, Influence of controllable massecuite properties on crystallizer processing & molasses exhaustion, Total solids, Viscosity & Exhaustibility. Mechanism of crystal growth, Influence of temp. & impurities on the crystallization rate. Crystal movement & concentration, Relation of crystal surface area with crystallization rate. Crystallizer treatment of final massecuite. Cooling of massecuite, cooling rates, Dilution Vs. Reheating, Purity drop relationship. Exhaustibility of molasses, Loss of sugar in molasses, Role of non-sugar to exhaustibility & Different types of crystallizers-Air cooled & water cooled batch & continuous horizontal & vertical crystallizers etc.

Reference Books—1. Principles of Sugar Technology Vol.1-3 by Peter Honig , Elsevier Pub. Co. Newyork

2.Cane Sugar Manufacture in India by D.P. Kulkarni , S.T.A.I., New Delhi

3. Hand Book of Cane Sugar Technology by R.B.L. Mathur, Oxford Pub. Co., New Delhi

SUBJECT: SUGAR TECHNOLOGY (CAPACITY & CHEM.CONTROL)

CODE: ST/207 **MAX. MARKS: 100**

CAPACITY

Selection of site, lay out plan of the factory, Mixed Juice Weighing Scale, Mixed Juice Measuring Tanks, Juice Heaters, Sulphitation & Carbonation tanks , Defecators, Sulphur Furnaces, Air Compressor, Milk of lime preparation unit & pumps, Clarifiers, Settling Tanks, Rotary Vacuum Filter, Evaporators (Robert & long tube type), Syrup Sulphitation tanks, Melt & Syrup Clarification equipments.

CHEMICAL CONTROL

Boiling House Control- S.J.M. formula & its postulates, Winters formula, relation between S.J.M. & Winters formula.

Difference between Commercial Sugar, Standard Granulated & Equivalent Standard Granulated.

Difference between E.S.G. and Java crystal, calculation of E.S.G., calculation of clarification factor, actual molasses percent theoretical molasses & non sugar in molasses percent non sugar in mixed juice.

Calculation of Boiling House Recovery, Basic boiling House Recovery, Boiling House Performance & Boiling House Recovery (E.S.G.)

Comparison of Boiling House efficiencies of different factories, Reduced Boiling House Recovery, virtual purity of waste molasses, Reduced Boiling House Recovery by Noel Deerr & Gundu Rao formula, Reduced overall Extraction.

Quality assurance of the process by means of colour audit, conductivity audit etc.

Reference Books—1.Cane Sugar Manufacture in India by D.P. Kulkarni , S.T.A.I. New Delhi

2. Hand Book of Cane Sugar Engineering by E. Hugot, Elsevier Pub. Co.,Newyork

SUBJECT : MECHANICAL ENGINEERING

CODE: ST/208A **MAX. MARKS: 25**

1. Steam Generators:

Indian boiler regulations (IBR), Classifications and working of boilers, boiler mountings and accessories, Boiler Draught and its calculations, air pre-heater, feed water heater, super heater.

2. Steam Turbines:

Classification of steam turbine, Impulse and Reaction turbines, condensing, extraction-cum-condensing, back pressure, single stage; multistage turbines. Different types of Efficiencies , Compounding & Governing of steam turbines.

3. Air-Compressors:

Reciprocating and Rotary air compressors, air blowers, General working principles in respect of their capacity and pressure calculations, Utilization of compressors in the sugar industry.

4. Steam Condensers:

Function of condensers, Elements of Condensing Plant, Types of Condensers- Surface & Jet Condensers, Estimation of Cooling Water Required, Condenser Efficiency, Air Extraction, Cooling Towers, Cooling Ponds.

Reference Books—1. Thermal Engineering by R.S. Khurmi S. Chand& Co.,N.Delhi

SUBJECT: ELECTRICAL ENGINEERING

CODE: ST/208B **MAX. MARKS: 25**

1. 1. Principle of operation of induction motor, Construction features of induction motor, Classification of induction motors, Electromagnetic torque equation of induction motor, Slip-torque curve of induction motor, Losses in induction motor, Starting/ Braking of induction motors, Single phasing of induction motor

2. Principle of operation of synchronous generator, Construction features of synchronous generator, Excitation system of synchronous generator, Classification of synchronous generator, Parallel operating conditions of synchronous generator, Applications of synchronous generator
3. Concept of power generation, power transmission and power utilization in sugar industry.

Reference Books-

1. A Text Book of Electrical Technology by B.L. Theraja
2. Fundamental of Electric Machines by B.R. Gupta & Vandana Singhal

SUBJECT: SUGAR ENGINEERING

CODE: ST/209A **MAX. MARKS: 70**

1. Cane Handling and Regulated Cane Feeding

General aspects of mechanical un loader, truck tipplers, grab and sling bar systems, Hydro un loaders Auxiliary carriers, cane carriers and elevators.

2. **Cane Preparation** Different cane preparatory devices: kicker, leveler, cutter, swing hammer and fixed hammer, Shredders, Fibrizor, Mincer etc.
3. **Milling Tandem** Two &Three roller mills: general construction; functions; reduction gearing , role of surface speed in the milling operation. Idea about Pressure feeders, lotus roller etc.
4. **Boiler** General description of different types of furnaces like Step grate, Horse Shoe, Ward, Spread Stoker, Pulsating grate; Dumping grate, Travelling grate etc., Super heaters, Economizers, Air pre-heater, their construction and their contribution to heat recovery. Performance of boilers, equivalent evaporation and boiler heat balance, all above for bagasse as main fuel. General basics of incineration boiler. Determination of boiler efficiency.
5. **Turbine** Working principle, different types of turbines used in sugar industry, idea about specific steam consumption of different turbines.
6. **Boiler Feed Water** Requirement of water quality for boilers of different pressure, importance of water quality, Contamination, hardness and dissolved solids, chemical conditioning of boiler water and role of de-aerators.

Reference Books—1.Machinery & Equipments of Cane Sugar Factory by L.A. Tromp
20th Century pub. ,New Delh
2. Hand Book of Cane Sugar Engineering by E. Hugot ,Elsevier Pub.Co. Newyork

SUBJECT: INSTRUMENTATION

CODE: ST/209B **MAX. MARKS: 30**

1. Introduction to control system open loop and closed loop system along with examples related to sugar and allied Industry, types of control action such as two step control, proportional control, integral control, derivative control, (proportional +integral +derivative)/ PID control, Proportional Band/ Gain, reset time, rate time.
2. Pneumatic I/P convertor ,Pneumatic relay
3. Pneumatic control valve: construction, flow characteristics of control valve, valve body material, selection of control valve, Valve positioner.
4. Pressure switch, annunciation system.
5. Boiler drum level control, Raw juice heating control, imbibition water tank control viz. temperature level and flow control.

References Books- Process control Instrumentation Technology by Curtis D. Johnson , Pearson Publication.

SUBJECT:DRAWING & DESIGN

CODE: ST/210 **MAX. MARKS: 100**

1. Basic considerations of equipment design.
2. Juice Heater: Constructional details, Function of various parts of juice heaters, material of construction and its mechanical properties, types of juice heaters, Dead end & Dynamic. To find out the heating surface of juice heater as per known parameters, total no. of tubes, no. of tubes per pass, no. of passes, no. of compartment, dia. of tube plate, standard thickness of cover plate, header, shell and tube plate, size of steam entry, juice inlet/outlet, condensate outlet, vent pipes, height of headers above tube plate. Calculation of head loss.
3. Evaporator: Types – Roberts, Semi-kestner, Rising & falling film, Constructional and functional details, material of construction and its mechanical properties. For given heating surface determination of total no. of tubes, dia of down take, dia of tube plate, size of steam entry in calendria, juice inlet/outlet, condensate outlet, vent pipes. Height of vapour space above top tube plate. Standard thickness of body, shell, tube plate and bottom cone, design of internal catch-all.

Drawing Assignments

1. Juice Heater.
   a. General Arrangement b. Top and bottom header
2. Evaporator.
   a. General arrangement b. Tube plate
3. Pan
   a. General Arrangement b. Tube plate
4. Multijet condenser: General Arrangement
5. Practice on Computer Aided Drafting in Auto CAD Laboratory.

Reference Books— 1.Computer Aided Designee in Mechanical Engineering by V. Ramamurthy ,Tata Mc Graw Hill Pub. Co. Ltd., New Delhi

2- Hand Book of Sugarcane Engineering by E.Hugot.

SUBJECT: SUGAR CHEMISTRY (PRACTICAL)

CODE: ST/211 **MAX. MARKS: 50**

1. Volumetric analysis of;
   (i) Iron as $Fe_2 O_3$ (ii) Chloride as Cl (iii) Sulphate as So4
2. Analysis of Quick lime and Sulphur
3. Analysis of (i) TSS (ii) TDS (iii) Hardness (iv) Alkalinity in Boiler Feed water

SUBJECT: SUGAR TECHNOLOGY (PRACTICAL)

CODE: ST/ 212 **MAX. MARKS: 200**

1. Determination of total & free SO_2 content in juices, syrups, massecuites, molasses and sugars by:-a) Iodine method

b) Spectrophotometric method (Caruthers's Method)

2. Determination of ash in juices syrups, molasses & sugars by Gravimetric method (for sulphated Ash)

3. Determination of crystal % massecuite by:-

a) Laboratory centrifugal b) Purity method

4. Determination of size & shape of crystals in seed slurry & massecuites with the help of a microscope.

5. Determination of Pol % & Moisture % in sugar.

6. Colorimetric determination of turbidity in juices.
7. Demonstration of purity by Auto Pol analyzer system (Sucrolyser).
8. Determination of pol % & fibre % in sugarcane by direct & indirect methods.
9. Determination of preparatory index of prepared cane.
10. Colour determination of sugar in solid phase i.e. determination of Modulated Reflectance value (Demonstration practical).

Reference Books— System of Technical Control by N.C. Verma ,S.T.A.I. ,New Delhi

ASSOCIATESHIP COURSE IN SUGAR TECHNOLOGY
THIRD YEAR

SUBJECT: SUGAR CHEMISTRY (THEORY)
CODE: ST/301 MAX. MARKS: 50

1. Formation and accumulation of Sugar in Sugarcane.
2- Photosynthesis, site of sugar synthesis, radiant energy capturing by photo system I & II, Hill reaction, light and dark reaction, Photosynthetic phosphorylation, Reduction of CO_2 to form glucose (Calvin cycle or C_3 cycle) Regeneration of ribulose diphosphate, C_4 pathway of CO_2 fixation.
3- Synthesis of surcrose, movement of sucrose from the site of synthesis to the place of consumption or storage.
4- Post harvest deterioration of sugarcane, factors affecting post harvest deterioration, effect of post harvest deterioration on composition of sugarcane juice.
5- Role of various non sucrose constituents of sugar cane juice in the process of sugar manufacture.

Reference Books-1. Analytical Agriculture Chemistry by S.L. Chopra , Kalyani Pub. New Delhi
2.Hand Book of Cane Sugar Technology by R.B.L. Mathur , Oxford Pub. Co. New Delhi

SUBJECT: STATISTICAL QUALITY CONTROL
CODE: ST/302A MAX. MARKS: 30

Sampling Techniques, Sampling Definition, Sampling and non-sampling error, uses. Description of simple random sampling, stratified sampling, Systematic sampling. Two stage, Multistage sampling.
Reference Books— Fundamental of Applied Statistics by S.C. Gupta , S. Chand & Co. New Delhi

SUBJECT: BY PRODUCTS
CODE: ST/302B MAX. MARKS : 20

MOLASSES: Different types of molasses & their characteristics, alcoholic fermentation of molasses-manufacture of rectified spirit, denatured spirit and power alcohol. potable liquors etc, Manufacture of citric acid, lactic acid and manufacture of bakers' yeast from molasses.
Reference Books—By Products of Cane Sugar Industry by J. M. Paturau ,Elsevier Pub. Co. New york

SUBJECT: **BUSINESS MANAGEMENT**

CODE: ST/303A **MAX. MARKS: 25**

1. Production management and control-definition factors influencing production control, production planning, types of production process.
2. Purchase organization and control, store keeping recording-centralized and decentralized purchasing.
3. Location of factory, layout of plant building etc. factors important in decision making about the location of an industry.
4. Sales organization and control. (Marketing concept, Marketing Mix, Introduction to Advertising)
5. Training of operation, types of training programme off the job and on the job training.(Training , Objective and Types- On the job training and off the job training)
6. Job analysis- Definition, important, characteristics job description and job specification.

Reference Books—1. Industrial Organization & Management by Lowrence L Bethel , Mc Graw Hill Pub. Co., Newyork

2. Principles and Practice of Management By T.N. Chabra , Dhanpatrai & Co., New Delhi

SUBJECT: COMPUTER AWARENESS

CODE: ST/303B **MAX. MARKS : 25**

UNIT-1 COMPUTER FUNDAMENTALS :-

Chapter -1 Computer Concept : Definition of computer, element of computer, Types of software.

Chapter -2 Parts of a computer : I/O devices, CPU, Auxiliary Storage Devices.

UNIT-2 Operating System :-

Chapter -1 Introduction to operating System, Function of operating System, Classification of Operating System

Chapter -2 WINDOWS : Various features of OS- WINDOWS .

UNIT-3 MS – Office :-

Chapter -1 MS –Word : Basic features of MS-Word Screen, Managing documents.

Chapter -2 MS- EXCEL : Basic of spreadsheet application, creating worksheet file, Doing calculations, creating charts

Chapter -3 MS-Power point : Starting MS power point, Using design templates, Working with slide master.

UNIT-4 Web Technology :-

Chapter -1 Internet basics: Definition of internet, use of internet, internet connection requirement.

Chapter -2 World Wide Web: Understanding www, web sites, browsers

UNIT-5 Visual Basics :-

Chapter -1 VB Environment : Tool Box, Project explorer windows

Chapter -2 VB Application : Creating & Designing form, working with common controls .

UNIT-6 Data Base :-

Chapter -1 Database Basics : DBMS, Functions of DBMS, Types of DB implementation models.

Reference Books: ''An introduction to database systems'' by Bipin Desai The complete reference visual basics.

SUBJECT: SUGAR ENGINEERING

CODE: ST/304A **MAX. MARKS : 70**

1. **Milling Tandem-** Different types of grooving and juice drainage systems, Mill settings, Hydraulic accumulator and calculation of hydraulic loads, Mill imbibition systems, Brief description of feeding arrangement viz. under feed rollers, pressure feeding devices (GRPF & TRPF), Power requirement for milling, Different types of driving arrangements for mills like steam turbines, DC electric drives, AC electric drives and hydraulic drives.
2. **Steam Economy-** Different systems of vapour bleeding like Single, Double Effect and Pre-evaporator, Calculation of complete steam balance of sugar plant, Importance of exhaust steam pressure and its temperature, Pressure reducing and de-superheating system (PRDS), Role of waste heat recovery.
3. Concept of co-generation system in sugar industry, Switch yard arrangement, Bagasse drying system.
4. Calculation of power balance of sugar plant, methods for reduction of captive power consumption.
5. Calculations of fuel balance, exhaust steam balance and steam consumption balance of sugar plant, Heat and mass balance diagram for the complete steam cycle.
6. Utilization of induction motors in sugar industry, Various speed control methods of induction motor including variable frequency drive (VFD) control method in detail.
7. Introduction of various types of switch gears (switches, circuit breakers, fuses, relays etc.) used in sugar industry, Power factor, Disadvantages of lower power factor, Causes of low power factor and ways to improve it.

Reference Books-

1. **Machinery & Equipments of Cane Sugar Factory by L.A. Tromp pub. Twentieth Century, New Delhi**
2. **Hand Book of Cane Sugar Engineering by E. Hugot Pub. Elsevier, Co. New York**
3. **Principles of Power System by V.K. Mehta, Rohit Mehta**
4. **Fundamentals of Electrical Drives by Gopal K Dubey.**

SUBJECT: INSTRUMENTATION

CODE: ST/304B **MAX. MARKS: 30**

1. Digital Technology: Data communication, Data acquisition, PLC, DCS, Elements of a DCS, Data highway, Digital field transmitter based on smart technology.
2. Application of Instrumentation to technology of sugar processing viz Milling (ACFC, JFS), Juice heater,Evaporator, Pan, Centrifugal, Drying, Warehouse, Co-Gen & Boiler.
3. Introduction to SCADA and is application to Sugar Industry.

Reference Books—1. Instrument Technology, Vol.1-4 by E.B. Jones ,English Language book Society, Butterworth

2. Instrument Engineers Hand Book by B.G. Lip Tak , Butter worths Hienemann Ltd. Oxford

SUBJECT: CHEMICAL ENGINEERING

CODE: ST/305 **MAX. MARKS: 100**

1. General Chemical Technology. Study of the process technology of the following.
   (a) Sulphur dioxide and sulphuric/ sulphurous acid from sulphur, Heat recovery.
   (b) Pulp and paper-manufacture evaporation of chemical recovery & waste treatment.
   (c) Lime (d) Carbon dioxide
   (d) Activated Carbon (f) Surface coatings- paints, pigments and varnishes
2. Waste water engineering
   (a) Introduction to waste water treatment and its reuse.
   (b) Basic principles of waste water treatment – Primary, Secondary and Tertiary.
   (c) Condensate utilization, problems and precautions to be taken for condensate utilization at boilers.
   (d) Heat recovery from condensate and its impact on energy economy.
   (e) Waste water treatment practice in sugar factory and Zero effluent discharge.

Reference Books—

1. Dryden's Dutlines of Chemical Technology-Affiliated East-west Press Pvt. Ltd.

2. Environmental Pollution Control Engineering- C.S. Rao (New Age + wiley Eastern Ltd.)

SUBJECT: SUGAR TECHNOLOGY (Mfg.-I)

CODE: ST/306 **MAX. MARKS: 75**

Clarification

Theory of Ion exchange, use of Ion- exchange resins, application of Ion exchange, techniques of Ion-exchange, regeneration of resins. Syrup & Melt Treatment, clarification of syrup & melt, pH & brix of syrup. Separation of sediments by centrifuging technique or flotation, super centrifuging for separation of sediments. Decolonization of sugar syrups using Ion-exchange , carbon columns. Practical problem related to subject. Idea of membrane filtration.

"Filtration Techniques use of leaf filters, candle filters and deep bed filters, Regeneration of Granular activated carbon. "

Sugar refining- Affination, filtration, phosphotation and carbonation process of clarification, boiling schemes, idea about massecuite % cane & steam consumption, blending of sugars, requirement of process chemicals, preliminary idea about manufacture of sugar cube & candy sugar. Practical problem related to subject. Operation of floatation clarifier and Aerator, chemical requirement in phosphotation carbonation process, Brine recovery system, melt concentrator, gas scrubbing system for CO_2, colour balance in Refinery."

Process options for making low ICUMSA sulphurless Sugar.

Reference Books—1. Principles of Sugar Technology Vol.1-3 by Peter Honig ,Elsevier pub. Co. Ltd., New york

2.Cane Sugar Manufacture in India by D.P. Kulkarni , S.T.A.I. ,NewDelhi

SUBJECT: SUGAR TECHNOLOGY (Mfg. -II)

CODE: ST/307 **MAX. MARKS: 75**

1-Centrifugals

Different types of centrifugals (batch & continuous machines), Selection of centrifugals for different massecuite gravity factor, high gravity factor machines, thyristor control centrifugals, time settings in centrifugals, fitting of liners & inter liners, washing of sugars, use of hot & cold water, steaming arrangements, disposal of molasses, different types of pug mills, idea about semi-automatic and automatic centrifugals, factors leading to rise of purity in continuous centrifugal.

2- Conventional sugar driers (Grass Hoppers)and fluidized static bed driers ,Rotary driers, air blowers, heating equipments dust collector, breakage of crystal, luster of sugar, type of Graders,

type of screens , size of mesh, grading of sugar, sugar storage bins, automatic bagging & weighing system. De-dusting system for collection of dust, calculation of MA/CV.

3- Storage of sugar, keeping quality of sugar, construction of sugar godown as per BIS standards, method of stacking of sugar bags, storage of molasses in steel tanks & pits & their requirements, deterioration & auto combustion of molasses during storage.

Advantages & disadvantages of different methods of sugar packing, mechanical handling of sugar bags. Sugar conditioning in silo

4-Pan boiling

Different boiling schemes- 6 massecuite boiling scheme(in case of refineries) & back boiling system, 4 massecuite, 3 massecuite, 3 ½ & 2 massecuite boiling & control of molasses purity, steam consumption at pans with different pan boiling schemes, Cobenze's formula & solid balance, quantities of massecuite, crystal % massecuite & apparent crystal volume, exhaustibility of molasses & factors affecting exhaustibility, standard specification of raw sugar, white sugar & refined sugar, classification of Indian white sugar with respect to grain size & color. Practical problems related to subject, Block diagram & step of pan automation.

Reference Books—1.Introduction to Cane Sugar Technology by G. H. Jankins ,Elsevier Pub. Co. Ltd. ,Newyork

2.Cane Sugar Manufacture in India by D.P. Kulkarni, S.T.A.I., New Delhi

3.Low Grade Sugar Crystallisation by E.E. Gillett ,S.T.A.I.,New Delhi

SUBJECT: SUGAR TECHNOLOGY (Manf.-III)

CODE: ST/308 **MAX. MARKS:75**

Sugar Beet**:-**

1. (a) Beet harvesting & its supply to sugar factories, distribution of sugar in beet root, chemical composition of sugar beet, primary operation equipment-beet silos, fluming channel, finger gate, beet pulp, stone catcher; leaf & wood catcher; beet washer; beet elevator & beet slicer & beet pulp press for dewatering of pulp, manufacturing process of Sugar from Sugar-beet in brief.

(b) Cane & beet diffusers- Concept of diffusion; difference between diffusion & lixiviation; principle of sugar cane & sugar beet diffusion; cane diffusers. Continuous diffusers based on percolation, maceration, maceration-cum-squeezing system; detailed features of cane & beet diffusers available, De-Smet, Saturn, D.D.S.. Different dewatering equipment namely, Succalton or Fentch screw press & three roller mills. Extraction limits of diffusion (Equivalent to R.M.E.)

2. **Open pan boiling:** Khandsari & gur processing clarification, sugar manufacture by open pan system, method of juice extraction, clarification and concentration in Khandsari & gur industry, difference between open & vacuum pan boiling.

3. **Raw sugar production**- Specification of raw sugar, process of manufacture including clarification, evaporation & crystallization, boiling schemes. Raw sugar storage & transport.

Reference Books—1. Hand Book of Sugar Refining by Chungchi Chou , John Wiley & Sons Newyork

2.Beet Sugar Technology by R. A. mcginnis, Reinhold publishing Corp. Newyork

SUBJECT: SUGAR TECHNOLOGY (CAPACITY)

CODE: ST/309 **MAX. MARKS: 50**

Condensers, cooling system, injection & spray pumps, syrup & molasses tanks, vacuum pans, crystallizers, centrifugal machines, storage of sugar & molasses Practical problem related to subject. Capacity Calculation of Continuous Pan & VCP.

Method adopted to reduce steam consumption to 36% in modern sugar plant with effective use of flash heat recovery system, other waste heat recovery systems and by extensive vapour bleeding schemes. Capacity calculation of VCP. Rotary drier fluidized bed drier, Rotary pan, air cooled condenser, surface condenser. Calculation of air requirement for drying of sugar.

Reference Books—1.Cane Sugar Manufacture in India by D.P. Kulkarni, S.T.A.I., New Delhi
2.Hand Book of Cane Sugar Engineering by E. Hugot, Elsevier Pub. Co. New york

SUBJECT: SUGAR TECHNOLOGY (CHEM. CONTROL)

CODE: ST/310 **MAX. MARKS : 50**

1. Stock taking, preparation of various balance viz. Pol balance, Non sugar balance & Crystal balance, comments on various balances & known & unknown sugar losses.
2. Time account, capacity utilization – crushing rate/24 hours operation & crushing rate/22 hours operation. Practical problems related to subject.
3. Writing Data for RT 7(C), RT 8(C), its analysis and interpretation.
4. BIS and FSSAI Certification for sugar.

SUBJECT: DRAWING & DESIGN

CODE: ST/311 **MAX. MARKS: 100**

1. **Pan:** Types – Batch & continuous, Constructional and functional details, Material of construction and its mechanical properties, optimum design parameters, graining volume, hydrostatic head, circulation ratio and S/V ratio, determination of heating surface, total no. of tubes, dia of down take, dia. of tube plate, standard thickness of body, shell, tube-plate and bottom cone. Calculation of graining volume, hydrostatic head above top tube plate, vapour space above strike level, size of steam entry in calandria, condensate outlet, vent pipes, discharge valve. Design of internal catch all. Rotary pan.
2. **Condenser** : Constructional and functional details, Material of construction and its mechanical properties. Types of condensers and its application. Performance parameter – Approach Temperature.

(a) **Multi jet Condenser** : Determination of the size of vapor pipe, dia. & height of condenser, quantity of injection water, quantity of injection water in spray and jet nozzles, no. and size of spray nozzles, no. and size of jet nozzles, size of injection water pipes, tail pipe.

3. **Crystallizer** : Constructional and functional details, material of construction and its mechanical properties. Type of crystallizers i.e. batch and continuous type. Horizontal & vertical. Calculation of the capacity of crystallizer, No. of crystallizers, dimensions of crystallizers, cooling surface of batch type and continuous crystallizers.
4. **Molasses Storage Tank** : Material of construction and mechanical properties. Optimum tank proportions, Factors, influencing the optimum tank proportions. Determination of number and capacity of each molasses tank. Dia. and height of molasses tank, no. and size of courses, standard thickness of bottom plate & roof plate.
5. Different types of fluidized bed drier, rotary drier.