

# **RANI CHANNAMMA UNIVERSITY, BELAGAVI**



## **CURRICULUM STRUCTURE (I to VI Semesters)**

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### **B.Sc. Sugar Science & Technology**

**THE COURSE STRUCTURE AND SYLLABUS OF  
UNDER GRADUATE**

**B. Sc. (Sugar Science & Technology)**

**I - SEMESTER**

**Academic Year 2020-21**

## SEMESTER – I

Sl. No	Course code	Name of course	Teaching hours	Duration of Exam	Marks			Credits
					IA	Exam	Total	
1		English	4	3	20	80	100	3
2		MIL	4	3	20	80	100	3
3	<b>C1 T</b>	Chemistry – I, 20SS103T	4	3	20	80	100	3
4	<b>C1 P</b>	Chemistry Practical-I, 20SS104P	3	3	10	40	50	1
5	<b>C2 T</b>	SST– I A, (Juice extraction & clarification) 20SS105T	4	3	20	80	100	3
6	<b>C2 P</b>	SST– I A, Practical, 20SS106P	3	3	10	40	50	1
7	<b>C3 T</b>	SST– I B, (Sugar Cane Production Technology), 20SS107T	4	3	20	80	100	3
8	<b>C3 P</b>	SST– I B, Practical, 20SS108P	3	3	10	40	50	1
9	<b>AECC</b>	Indian Constitution	2	2	10	40	50	2
10		CC/EA			50		50	1
<b>TOTAL</b>								<b>21</b>

Total teaching hours per week: 31

Total credits in semester: 21

\*Sugar Science & Technology – SST

T: Theory, P: Practical, CC/EA: Co-Curricular/Extension Activities, AECC: Ability Enhancement Compulsory Course

## SEMESTER I

Course code: **20SS103T**

Course: **CHEMISTRY - I**

**Total Teaching Hours : 60 hours**

**Teaching Hours / week: 4 Hours**

**Credits – 3**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

## INORGANIC CHEMISTRY

### Unit-I

#### Atomic structure

**5 Hours**

Review of Bohr's model of hydrogen atom-Postulates of Bohr's theory, Bohr's theory of hydrogen atom, calculation of radius and energy of  $n^{\text{th}}$  orbital, electronic transitions and origin of spectral lines of hydrogen atom.

Quantum numbers and their significance.

### Unit-II

#### Periodic trends

**4 Hours**

The modern periodic law, Periodicity properties, Classification elements into s, p, d and f blocks, comparative studies of elements group I & II (With respect to ionic radii, ionization Energy, Anomalous behavior of Li & Be), electronic configuration of the elements up to atomic number 60, Aufbau's principle, Hund's rule, (n+1)rule, Pauli's exclusion principle.

### Unit-III

#### Chemical bonding – I

**5 Hours**

**Ionic bonding:** factors affecting the formation of ionic bonding, Lattice energy and its determination by Born-Haber cycle.

**Covalent bond:** Types, factors favoring covalent bond, properties of covalent bond: Types, factors favoring covalent bonds, properties of covalent compounds.

Valence bond theory with respect to  $\text{H}_2$ ,  $\text{F}_2$ ,  $\text{HCL}$  molecules and its limitations.

## **Unit-IV**

### **Methods of analysis**

**4 Hours**

Errors in quantitative analysis, classification and minimization, accuracy, precision standard deviation, t-test, significant figure and rules for computations.

## **ORGANIC CHEMISTRY**

### **Unit-I**

**12 Hours**

**Carbohydrates I :** Introduction, definition and classification, D and L structure of glucose, Haworth and Fischer structure of (+)-Glucose and (-)-Fructose, Stereoisomers of (+)-glucose, Oxidation of (+)-Glucose by Nitric Acid, Osazone formation of (+)-Glucose and (-)-Fructose, Conversion of aldose into Ketose, Formation of glycosides, Configuration about C-1 (anomers), Methylation, Mutarotation, Structure and composition of Disaccharides(+)-Sucrose, (+)-Maltose, (+)-Lactose, Polysaccharides starch and cellulose structures, Reducing and Non-reducing sugars.

### **Unit-II**

**8 Hours**

#### **Stereochemistry of organic molecules**

Cycloalkanes: Baeyer's strain theory, calculation of angle strain, Sachse Mohr theory of strainless rings. Chair and boat forms of cyclohexane. Axial and equatorial bonds.

**Conformational isomerism:** Basic concept of conformational analysis with reference to ethane and butane.

**Geometrical isomerism:** definition, E and Z notation for 2-butene and butenedioic acid, rules for assigning notations. Determination of configuration of butenedioic acid by anhydride formation, dipole moment measurement melting point and stability.

**Optical isomerism:** Chirality, van't Hoff-Lebel hypothesis, optical activity, D and L-configurations, R and S notations, sequence and priority rules, enantiomers, diastereoisomers, epimers, anomers, racemic and meso (with suitable examples like lactic and tartaric acids.), racemisation resolution of racemic mixture by chemical method, asymmetric synthesis, Walden inversion.

## PHYSICAL CHEMISTRY

### Unit-I Gaseous state

8 Hours

Real gas isotherms, Andrew's experiment of  $\text{CO}_2$ , PV-relationship, critical phenomenon of gases.

Critical constants( $P_c$ ,  $V_c$ ,  $T_c$ ). Definition of critical temperature, critical pressure and critical volume.

Relationship between critical constants and Vanderwaals constants. Experimental determination of critical constants, reduced equation of state and statement of law of corresponding states.

Liquification of gases (Linde's method only), Maxwell's law of distribution of molecular velocities(No derivation), effect temperature on distribution of molecular velocities.

### Unit-II

#### Solutions

5 Hours

Solutions of gas in liquid. Henry's law and limitations. Completely miscible liquid pairs. Azeotropes, theory of azeotropic mixtures, partially miscible liquid systems, critical solution temperature with respect of phenol-water, triethyl amine-water and nicotine-water system.

### Unit-III

#### Salt-hydrolysis

5 Hours

Types of salts, definition of degree of hydrolysis and hydrolysis constant derive the relation between  $K_h$ ,  $K_a$  &  $K_w$  and expression for pH in case of hydrolysis of the following – salts of weak base and strong acid, weak acid and strong base. Numerical problems.

### Unit-IV

#### Nernst distribution law

4 Hours

Statement and limitations. Applications of Nernst distribution law in solvent extraction.

**Semester I**  
**Course code: 20SS104P**  
**Course: CHEMISTRY PRACTICAL - I**

**Total Hours : 45 hours**

**Teaching Hours / week:3 Hours**

**Credits – 1**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

- A. Demonstration of calibration of glasswares (Burette, pipette) and weights (grams and milligrams)
- B. Preparation of standard solution, calculation of mass of the solute to be dissolved in 250 ml solution to get required normally.
- C. Volumetric estimations:
- i. Preparation of standard sodium carbonate solution (Idea of primary standard solution), standardization of HCL and estimation of NaOH using standard HCL solution.
  - ii. Preparation standard oxalic acid solution, standardization of  $\text{KMnO}_4$  solution and estimation of FAS solution.
  - iii. Preparation of standard potassium dichromate, standardization of ferrous sulphate solution and estimation of  $\text{KMnO}_4$  using standard ferrous sulphate solution.
  - iv. Estimation of iodine using standard thiosulphate solution.
  - v. Estimation of zinc using standard EDTA solution.
  - vi. Estimation of total hardness using standard EDTA solution.
  - vii. Estimation of available chlorine in bleaching power by iodometric method.
  - viii. Estimation of carbonate of bicarbonate in a mixture using phenolphthalein and methyl orange indicators.
- D. Simple gravimetric experiments
- E. Determination of the percentage loss in weight of I) Zinc carbonate II) barium chloride III) mixture of barium sulphate and ammonium chloride IV) mixture of zinc oxide and zinc carbonate on heating.

## REFERENCE BOOKS

### Inorganic chemistry

- |  |                                  |
|--|----------------------------------|
| 1. Advanced Inorganic chemistry              | Cotton and Wilikinson            |
| 2. Concise Inorganic chemistry               | J. D. Lee                        |
| 3. Inorganic chemistry                       | Huhee and Keiter                 |
| 4. Inorganic chemistry                       | Shriver and Atkin                |
| 5. Principles of Inorganic chemistry         | Puri and Sharma                  |
| 6. Inorganic chemistry                       | A. G. Sharpe                     |
| 7. Essential chemistry                       | R. Chand                         |
| 8. University chemistry                      | Mahan and Myers                  |
| 9. Modern Inorganic chemistry                | Madan                            |
| 10. Modern Inorganic chemistry               | Satya prakash                    |
| 11. Inorganic chemistry for Under Graduates  | R. Gopalan                       |
| 12. Collage Practical chemistry              | Ahluwalia, Dhingra<br>and Gulati |
| 13. Instrumental method of Chemical analysis | Willard, Martin and Dean         |

### Organic chemistry

- |                                   |                         |
|-----------------------------------|-------------------------|
| 1. Text book of Organic chemistry | Bahl and Bahl           |
| 2. Organic spectroscopy           | P. S. Kalsi             |
| 3. Organic chemistry              | I.L. Finar Vol I and II |
| 4. Advanced Organic chemistry     | Jerry March             |
| 5. Organic chemistry              | Morrison & Boyd         |
| 6. Modern Organic chemistry       | Norman & Wadding        |

### Books recommended for Physical chemistry:

- |                                       |                        |
|---------------------------------------|------------------------|
| 1. Physical chemistry                 | P. W. Atkins           |
| 2. Introduction to Physical chemistry | Mark Latd              |
| 3. Text book of Physical chemistry    | S. Glastone            |
| 4. Principles of Physical chemistry   | Puri Sharma & Pathania |
| 5. Text book of Physical chemistry    | P.L. Soni              |
| 6. Text book of Physical chemistry    | M.V. Sangaranarayanan  |



## **SEMESTER I**

**Course code: 20SS105T**

### **Course: SUGAR SCIENCE & TECHNOLOGY-I A JUICE EXTRACTION & CLARIFICATION**

**Total Teaching Hours : 60 hours**

**Teaching Hours / week: 4 Hours**

**Credits – 3**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

#### **Unit – I**

**10 Hours**

Definitions and concept of various terms used in sugar technology – Cane, Binding Material, Extraneous Matter, Pol, Brix, Recovery, Juice, Bagasse, Primary Juice, Secondary Juice, Maceration, Imbibition Water, Bagasse, Press Mud / Filter Cake, Clear Juice, Mixed Juice, Raw Juice, Filtrate, Syrup, Masecuite, Molasses, Final Molasses, Vacuum, Live Steam, Exhaust Steam, Vapour, Vacuum, Condensate, Boiler Water, Effluent, Spent Wash, Distillation, Fermentation, Etc ., General sugar processing flow diagram

#### **Unit – II**

**13 Hours**

Cane preparation & Milling : cane weighing, cane unloading system, General arrangement & working of cane carrier, feeder tables, cane preparatory equipments – leveler, cutter, fibrizer, shredder etc, Preparatory index, prepared cane carrier, General arrangement of mills & drive assembly, different parts of mill assembly, concept of mill & milling tandem, Working of mill, Juice extraction from cane, maceration and simple imbibition, compound imbibition, mill sanitation, raw juice screening , rotary screens, Mill extraction, Primary extraction, Bagasse & Juice quality, Measurement and weightment of juice – Mag flow / mass flow/load cell base weighing tank, Normal quantities of various products, Idea about diffusion.

**Unit – III****13 Hours**

Juice heating & clarification equipments: General Construction & working of Different types of juice heaters – Tubular /DCH/PTHE, Tubular heaters – HS, passes concept, heat transfer; General working sulphur burner, General construction & working of modern continuous sulphur burner, sulphur sublimation and reasons, Properties of SO<sub>2</sub> gas, Juice sulphiter working & construction details, Composition of cane and juice – their difference , principles of cane juice clarification, Effect of lime on the different constituents of juice, effect of pH, effect of heating, different processes of cane juice clarification, Juice sulphiter – working & construction, Concept of shock liming /preliming/simultaneous liming, Milk of preparation equipment working & construction details, Phosphoric acid preparation, Preparation of flocculants

**Unit – IV****12 Hours**

Definition of double sulphitation/phosphotation, chemicals used for juice clarification, physical & chemical properties of Sulphur, Lime, Phosphoric acids, settling agents, sulphur burning reaction, Action of lime/sulphur/phosphoric acid/settling agent on juice, Flocculent agents used for settling and their properties, dosing calculations for chemicals.

**Unit – V****12 Hours**

Clarifier & Vacuum Filter: General construction & working of various clarifiers - 444 clarifier / rapi clarifier/ Single tray (SRT) clarifier, vacuum filter, Types of clarification/juice sulphiter/sulphur burner/clarifier/vacuum filter

## **SEMESTER I**

**Course code: 20SS106P**

**Course: SUGAR SCIENCE & TECHNOLOGY-PRACTICAL-IA**

**Total Teaching Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week: 3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Brix Analysis by brix hydrometer
2. Use of polarimeter for Pol reading
3. Analysis of Primary juice /Mixed juice for Brix % , Pol % & Purity
4. Analysis of Bagasse for Pol % & moisture %
5. Analysis of Filter cake for Pol % & Moisture %
6. Calibration of pH meter and analysis of juice for pH
7. Analysis of RS % & RS per 100 brix in Primary juice & clear juice
8. Analysis of syrup for Brix % & purity
9. Analysis of CaO content in Mixed juice & clear juice
10. Analysis of bagacillo in mixed juice
11. Analysis of quick lime for available CaO content
12. Analysis of juice for dirt%

**Reference Books:**

1. Principles of sugar technology, Honig Pieter, Elsevier publishing company Amsterdam
2. Hand book of Cane Sugar Engineering, Hugot e., Elsevier Science publishing Co.Inc. New York.
3. Sugar Technology for Administrators in the Indian sugar factories; Manohar Rao,P.J.; Jayajirao Shinde Editor Bharatiya Sugar Jeevan Darshan Laxmi Rd. Pune.
4. Training manual for sugar mills.; Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
5. Efficient Management of sugar factories, Mangal Singh, Somaiya publication Pvt.Ltd. Bombay
6. Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
7. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
8. Hand book of Cane Sugar Technology, Mathur R.B.L., Oxford DBH publishing Co.N.Delhi.
9. Unit operations in cane sugar production; Payne, J.N.; Elsevier pub Co. Amsterdam.
10. Introduction to cane Sugar Technology, Jenkins, Q.H., Elsevier scientific publishing company Amsterdam.

## **SEMESTER I**

**Course code: 20SS107T**

**Course: SUGAR SCIENCE & TECHNOLOGY-IB**

### **SUGARCANE PRODUCTION TECHNOLOGY**

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

#### **Unit – I**

**06 Hours**

Origin, History and distribution of sugarcane growing regions of India. The taxonomic classification of sugarcane. Morphology – stem of sugarcane. Economic root system and inflorescence in sugarcane and growth phases in sugarcane. Economic important cane v/s beet sugar. Major varieties of sugarcane cultivated in Karnataka and their features.

#### **Unit – II**

**06 Hours**

##### **Ecology**

Temperature, Rainfall, Relative humidity (RH), Atmospheric Co<sub>2</sub> concentration, Sunlight, Frost, Wind, Microclimate, Effect of greenhouse gases (GHGs) on cultivation of sugarcane.

##### **Basic concepts of sugarcane physiology**

Photosynthesis, factors of influencing photosynthesis, effect of temperature, photoperiod, Transpiration, Growth promoters, Growth inhibitors.

#### **Unit – III**

**08 Hours**

Elements of Soils and their Characters; Definition of soil. Importance and functions of soils. soil profile, soil particles, structure, texture, density, porosity, physical properties, soil pH, Electrical Conductivity and Ion exchange process.

Soil organic matter, importance, characters and carbon and nitrogen ratio and its importance. Acid soils, saline and alkaline soils, their characters, formation,

problems and their management practices. Meaning of soil fertility, soil fertility deciding factors, plant nutrients and their classification. Essential nutrients, Forms of nutrients required by plant, movement of nutrients towards roots, availability of nutrients. Organics, meaning and classification / types. Nitrogen, Phosphorus and potassium fertilizers and their characters and reactions in the soil. Complex. Mixed and liquid fertilizers and micronutrient fertilizers. Soil analysis, Recommendations of fertilizers based on soil test results.

#### **Unit – IV**

**34 Hours**

#### **Production practices**

Land preparation: Preparatory tillage, green manuring and application of bulky manures, seed material and seed rate, geometry of planting and planting depth, planting period, agronomy of late planted crop, planting methods, mechanical planters, aftercare. Sugarcane based cropping and farming systems, companion cropping in sugarcane, sugarcane based farming systems.

#### **Nutrition and fertilizer management**

Time and method of N application, bio-fertilizers, Time and method of applying Bio-fertilizers, Ex situ composing of trash and press mud (modified Japanese method), Vermi-composting, major nutrients and micro nutrients.

#### **Integrated weed management**

Integrated weed control, herbicide, antidotes or softeners, surfactants and adjuvant, control of noxious, perennial weeds and methods of weed control measures.

#### **Water management:**

Irrigation water requirement, Evapo-transpiration (ET) Water use efficiency (WUE), Different methods of Irrigation, Furrow method of irrigation Sprinkler irrigation, and Drip or trickle Irrigation.

### **Management of seed cane**

Sett treatment, agronomy of seed cane, thermotherapy or heat therapy and Three-tier seed programme. Tissue culture and its importance in seed programme.

### **Pests and disease management**

**Pests:** Shoot borer, top borer, internode borer, stalk borer, gurudaspur borer, root borer, White Grubs, Termites, Scale insect: (Green), Pyrillapurpusilla, Walker), White flies, Non-insect pests, Biological control of sugarcane pests, parasites.

**Diseases:** Red rot, Smut, Wilt, Pineapple disease, Yellow Leaf Disease (YLD), Leaf spots, Ratoon stunning disease (RSD), Grassy Shoot Disease (GSD), Nematodes and Mosaic.

### **Management of ratoon cane**

Importance of Ratoon management Ratoon cane Management practices, Time and method of fertilizer application, yield attributes of ratoon cane, ratoon v/s plant cane. Water requirement, gap filling, trash management, management of weeds, pests, and diseases associated with ratoon effect of growth regulators on sprouting and ratoon yield,

### **Unit – V**

**06 Hours**

Ripening methods, Methods of cane purchase, Harvest strategy, Pre-harvest maturity survey, Methods of harvest, Mechanized harvesting. Quality assessment of late harvested cane, Composition of sugarcane and juice and quality parameters of juice, Post harvest losses and measures to reduces the losses. Cost of cultivation of sugarcane.

## **SEMESTER I**

**Course code: 20SS108P**

**Course: SUGAR SCIENCE & TECHNOLOGY-IB**

**Total Teaching Hours : 45 hours**

**Teaching Hours / week: 3 Hours**

**Credits – 1**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Identification of important sugarcane varieties.
2. Soil collection process and interpretation of soil test results.
3. Calculation of fertilizer dose based on soil test report.
4. Identification of Pests and diseases.
5. Analysis of brix of cane sample by hand refractometer at various portion of the cane.
6. Analysis of cane sample for pol % - Cane weighment, Juice weighment, analysis of bagasse for pol % & moisture %, Analysis of juice for Brix %, Pol %, purity,
7. Quality analysis of Early & late maturing cane
8. Working of cost of cultivation of sugarcane.
9. Post harvest deterioration analysis and interpretation.



## REFERENCE BOOKS:

1. Hartmann and Kester's – Plant propagation – Principles and practices – Hudscan T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. Robert L. Geneve.
2. Textbook of Plant Physiology – C. P. Malik
3. Diseases of Crop plants in India – G. Rangaswami and A. Mahadevan
4. Plant Pathology – R. S. Mehrotra
5. Practical cytology – Applied Genetics and Biostatistics – H. K. Goswami and Rajeev Goswami
6. Recent Advances in Plant Diseases Vol-1 to 5-K.M. Chandniwala
7. Introduction to Principles of Plant Pathology – R.S. Singh
8. An Introduction to Plant Anatomy – Authur R. Eames and Laurence H. Mac Deniels.
9. Genetics and Plant Breeding – E. B. Babcock
- 10.Plant Taxonomy – O.P. Sharma
- 11.Plant Breeding – Theory and Techniques – S.K. Gupta
- 12.Breeding Asian Field Crops – John Milton Poehlman and Dhirendranath Borthakur.
- 13.Crop Production and Field Experimentation – Dr. V. G. Vaidya, K. R. Sahasrabudhe, Dr. V. S. Khuspe.
- 14.Agricultural Problems of India – A. N. Agrwal and Kundam Lal
- 15.Elementary Principles of Plant Breeding – H.K. Chaudhari
- 16.Trends in Agricultural Insect Pest Management – G.S. Dhaliwal and Ramesh Arora.

**THE COURSE STRUCTURE AND SYLLABUS OF UNDER  
GRADUATE**

**B. Sc. (Sugar Science & Technology)**

**II - SEMESTER**

**Academic Year 2020-21**

## SEMESTER – II

Sl. No	Course code	Name of course	Teaching hours	Duration of Exam	Marks			Credits
					IA	Exam	Total	
1		English	4	3	20	80	100	3
2		MIL	4	3	20	80	100	3
3	<b>C4 T</b>	Chemistry – II, 20SS203T	4	3	20	80	100	3
4	<b>C4 P</b>	Chemistry Practical II, 20SS204P	3	3	10	40	50	1
5	<b>C5 T</b>	<b>SST– IIA</b> , (Evaporators ), 20SS205T	4	3	20	80	100	3
6	<b>C5 P</b>	<b>SST–II A</b> , Practical, 20SS206P	3	3	10	40	50	1
7	<b>C6 T</b>	<b>SST– IIB</b> , (Sugar Factory Chemical Control), 20SS207T	4	3	20	80	100	3
8	<b>C6 T</b>	<b>SST–II B</b> , Practical, 20SS208P	3	3	10	40	50	1
9	AECC	Environment Science	2	2	10	40	50	2
10		<b>CC/EA</b>			50		50	1
<b>TOTAL</b>								<b>21</b>

Total teaching hours per week: 31

Total credits in semester: 21

\*Sugar Science & Technology – SST

T: Theory, P: Practical, CC/EV: Co-Curricular/Extension Activities, AECC: Ability Enhancement Compulsory Course,

## SEMESTER II

Course code: **20SS203T**

Course: **CHEMISTRY - II**

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

### INORGANIC CHEMISTRY

#### Unit-I

##### Chemical bonding – II

**10 Hours**

**Hybridization:** Salient features of hybridization, geometry of molecules with respect to  $sp$ ,  $sp^2$ ,  $sp^3d$ ,  $sp^3d^2$  hybridization.

VSEPR theory – Postulates, regular and irregular geometry ( $BF_3$ ,  $CH_4$ ,  $NH_3$  and  $H_2O$ ). Molecular orbital theory: LCAO concept, elementary account with respect to  $H_2$ ,  $He_2$ ,  $Li_2$ ,  $B_2$ ,  $N_2$ ,  $O_2$ ,  $O_2^+$ ,  $O_2^-$  and  $O_2^{2-}$  molecules, calculation of bond order, stability, magnetic properties etc.

Hydrogen bonding: Types, significance of hydrogen bonding properties explained by hydrogen bonding like a) State of  $H_2O$  and  $H_2S$  b) Melting and Boiling point c) Ice has less density than water.

#### Unit-II

**3 Hours**

##### Organic reagents in inorganic analysis

Sensitivity, selectivity and specificity, advantages of organic reagents over inorganic reagents – Dimethyl glyoxime (DMG), 8-hydroxy quinoline (oxine).

#### Unit-III

**5 Hours**

##### Principles of volumetric analysis

Concentration terms, normality, molarity, mole fraction, percentage, primary standards solution, titration-acid-base, precipitation, iodometric redox and complexometric (with reference to EDTA) titrations, choice of indicators in the above titrations.

## ORGANIC CHEMISTRY

### Unit-I

8 Hours

#### Purification of organic compounds

**Methods of purification of solids:** Crystallization, fractional crystallization and sublimation.

**Methods of purification of liquids:** Distillation, fractional distillation, distillation under reduced pressure, steam distillation.

**Chromatography:** General principles, types, brief outline of thin layer chromatography, paper chromatography and column chromatography solvent extraction.

Criteria of purity: Melting point and boiling point.

### Unit-II

6 Hours

#### Spectroscopy

Introduction, Electromagnetic spectrum.

**UV spectroscopy:** Principle, types of transitions, chromophores, concept of auxochromes and their effect on Wave length max. Bathochromic shift, hypsochromic shift, hypochromic and hyperchromic shift.

Woodward and Fieser rules and illustration of calculation of  $\lambda_{\max}$  taking myrcene and B-phelladrene and examples.

#### Aromatic Hydrocarbons

6 Hours

Resonance in benzene, Aromaticity – Huckel's  $4n+2$  rule with respect to benzene, furan, pyridine and (10) – Annulene.

Mechanism of electrophilic aromatic substitution – halogenations, nitration, sulphonation and Friedel-craft's reaction (evidences for two step mechanism and evidences for formation of electrophile)

## PHYSICAL CHEMISTRY

### **First law to thermodynamics**

**6 Hours**

Statement, isothermal and adiabatic process, expression for work done in the reversible expansion of adiabatic expansion of an ideal gas ( $PV.=\text{Constant}$ )  
Joule-Thomson effect, Joule-Thomson experiment, derivation of Joule-Thomson coefficient for an ideal gas and inversion temperature.

**Thermochemistry:** Kirchoff's equation, bond energies and bond dissociation energies, calculation of bond energy and bond dissociation energies by taking simple molecules. Numerical problems.

### **Liquid State: Physical properties of Liquids**

**6 Hours**

Surface Tension: Effect of temperature on surface tension Determination of surface tension of liquid by drop numbers method, parachor and its applications.

**Viscosity:** Effect of temperature on viscosity, determination of relative, absolute and intrinsic viscosity of liquids by ostwald's viscometer method.

Refractive index of liquid: specific and molar refractions, determination of refractive index of liquid by Abbe's refractometer.

### **Colloids**

**5 Hours**

**Emulsions:** Types of emulsions, Preparation and emulsifiers.

**Gels:** Classification, preparation and properties, general application of colloids.  
Colloids in sugarcane.

### **Solids**

**5 Hours**

Space lattice, unit cell, crystal systems, calculation of particles per unit cell, laws of crystallography, crystallography of sucrose, x-ray diffraction of crystals, derivation of Bragg's equation, Miller indices, determination of structure of NaCl by rotating single crystal method.

**SEMESTER II**  
**Course code: 20SS204P**  
**Course: CHEMISTRY PRACTICAL - II**

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

**A. Organic spotting:** Identification of following organic compounds and preparation of their derivatives and confirmation by melting points:

1. Oxalic Acid
2. Phenol
3. Naphthalene
4. Urea
5. Benzaldehyde
6. 1-Naphthol
7. Phthalic acid
8. 2-Naphthol
9. Aniline
10. Acetanilide
11. Benzamide
12. Benzoic Acid
13. Salicylic Acid
14. Acetone
15. Ethyl benzoate

**B. Identification by**

1. Element determination
2. Solubility
3. Functional group
4. Physical constant
5. Preparation of derivatives and finding melting points

### Reference books for Inorganic chemistry

- |  |                                  |
|--|----------------------------------|
| 1. Advanced Inorganic chemistry              | Cotton and Wilikinson            |
| 2. Concise Inorganic chemistry               | J. D. Lee                        |
| 3. Inorganic chemistry                       | Huhee and Keiter                 |
| 4. Inorganic chemistry                       | Shriver and Atkin                |
| 5. Principles of Inorganic chemistry         | Puri and Sharma                  |
| 6. Inorganic chemistry                       | A. G. Sharpe                     |
| 7. Essential chemistry                       | R. Chand                         |
| 8. University chemistry                      | Mahan and Myers                  |
| 9. Modern Inorganic chemistry                | Madan                            |
| 10. Modern Inorganic chemistry               | Satya prakash                    |
| 11. Inorganic chemistry for UnderGraduates   | R. Gopalan                       |
| 12. Collage Practical chemistry              | Ahluwalia, Dhingra<br>and Gulati |
| 13. Instrumental method of Chemical analysis | Willard, Martin and Dean         |

### Books recommended for Organic chemistry

- |   |                                     |
|---|-------------------------------------|
| 1. Organic chemistry                      | I.L. Finar Vol I and II             |
| 2. Organic chemistry                      | Morrison & Boyd                     |
| 3. Organic chemistry                      | F.A. carry and<br>R. J. Sundberg    |
| 4. Reaction Mechanism inOrganic chemistry | Singh and Mukherji                  |
| 5. Text book of Organic chemistry         | Bahl and Bahl                       |
| 6. Text book of Organic chemistry         | C. N. Pillai,<br>Universities Press |

### Books recommended for Physical chemistry:

- |                             |                       |
|-----------------------------|-----------------------|
| 1. Physical chemistry       | Puri and Sharma       |
| 2. Physical chemistry       | P.L. Soni             |
| 3. Physical chemistry       | Roberty A Alberty     |
| 4. Physical chemistry       | M.V. Sangaranarayanan |
| 5. Physical chemistry       | Atkins                |
| 6. Physical chemistry Bahl, | Madan and Tuli        |



**SEMESTER II**  
**Course code: 20SS205T**  
**SUGAR SCIENCE & TECHNOLOGY-IIA**  
**Course: EVAPORATOR**

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

**Unit – I**

**12 Hours**

**Evaporator basic:** Concept of live steam/exhaust steam/vapour, Heat transfer & condensation, Basic concept of evaporator body, Working & construction of Robert body, Evaporator body – Major accessories, steam distribution to calandria, juice distribution, Study of different types of evaporators, Rising & falling film evaporator,

**Unit – II**

**14 Hours**

**Evaporator operation:** single effect Vs multiple effect evaporator, vapour cell and pre evaporators, Rileuxe principles, Evaporation under vacuum, vacuum creation, Types of condensers – Barometric/multijet/single entry/counter current /co –current; removal of condensate and non condensable gases, Online Brix measuring devices

**Unit – III**

**12 Hours**

**Vapor Bleeding System:** Use of steam table, Vapour bleeding calculations for Quadruple & quintuple effect, Dessin's formulas, Specific evaporation coefficient calculation & importance, estimation of evaporation rate based on brix data, BPR and its calculations

**Unit – IV**

**12 Hours**

**Evaporator performance:** Calculations for HS / steam/ vapour/ juice, Factor affecting evaporator performance; operational problems, Comparative study of Quadruple Vs Quintuple effects. Modern evaporator configuration

**Unit – V****10 Hours**

**Evaporator operation & Cleaning:** Testing of evaporator bodies after maintenance, Procedure for starting of evaporator body, operating procedures, Liquidation procedure, Chemical cleaning of evaporator – Soda boiling & descaling procedures followed on general cleaning day. chemicals used/ concentration/process; Mechanical descaling of evaporator tubes.

## SEMESTER II

Course code: **20SS206P**

Course: **SUGAR SCIENCE & TECHNOLOGY-PRACTICALS-IIA**

**Total Hours : 45 hours**

**Teaching Hours / week:3 Hours**

**Credits – 1**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Analysis of RS % & RS per 100 brix in clear juice & syrup
2. Analysis of clear juice & syrup for ICUMSA colour
3. Estimation of % transmittance of clear juice
4. Analysis of quick lime – Available CaO, Unburnt %
5. Analysis of Milk of lime for slakability test
6. Analysis of condensate for – pH, TDS, Sugar test, Conductivity, COD
7. Evaporator scale analysis for various contents
8. Analytical of intermediate products of boiling house – Clear Juice / Syrup/ Masecuite / Molasses for RS% / Colour/
9. Turbidity in clear juice and syrup by ICUMSA method.
10. Analysis of conductivity ash % of clear juice /syrup/ molasses
11. Estimation of RS/Ash ratio of clear juice / syrup / molasses
12. Analysis of Carbonated and sulphated ash % - Final molasses.

## Reference Books:

1. Principles of sugar technology, Honig Pieter, Elsevier publishing company Amsterdam
2. Hand book of Cane Sugar Engineering, Hugot e., Elsevier Science publishing Co.Inc. New York.
3. Sugar Technology for Administrators in the Indian sugar factories; Manohar Rao,P.J.; Jayajirao Shinde Editor Bharatiya Sugar Jeevan Darshan Laxmi Rd. Pune.
4. Training manual for sugar mills.; Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
5. Efficient Management of sugar factories, Mangal Singh, Somaiya publication Pvt.Ltd. Bombay
6. Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
7. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
8. Hand book of Cane Sugar Technology, Mathur R.B.L., Oxford DBH publishing Co.N.Delhi.
9. Manufacture and Refining of Raw cane sugar; Baikow, V.E., Elsevier publishing Co. Am Sterdam London New-york.
10. Unit operations in cane sugar production; Payne, J.N.; Elsevier pub Co. Amsterdam.
11. Machinery and Equipment of the cane sugar factory, Tromp, L.A., Norman Rodger, 7 & 8 Idol Lane.
12. Sugar Science and Technology, Birch, G.G. Parker, K.J. Applied science publishers Ltd. London.
13. The principles of cane sugar manufacture, Davies, J.G., Norman Rodger; London
14. Technology for sugar Refinery Workers, Oliver Lyle, Chapman & Hall Ltd. London
15. Introduction to cane Sugar Technology, Jenkins, Q.H., Elsevier scientific publishing company Amsterdam.
16. Industrial utilization of sugar cane and its Co-products , Manohar rao, P.J. , ISPCCK publishers & Distibutors N.Delhi

**SEMESTER II**  
**Course code: 20SS207T**  
**SUGAR SCIENCE & TECHNOLOGY-IIB**  
**Course: SUGAR FACTORY CHEMICAL CONTROL**

**Total Teaching Hours : 60 hours**  
**Teaching Hours / week: 4 Hours**

**Credits – 3**  
**Max. Marks: 100**  
**Marks: Theory- 80+IA-20**

**Unit – I** **12 Hours**

**General:** Weighment system & estimation of % cane figures – MJ/imbibition/bagasse, Calculation for estimation of Pol in bagasse, Pol in MJ, Pol % cane.

**Unit – II** **12Hours**

**Milling control:** Fundamental equations for milling control, Mill extraction, fiber % cane, fiber % bagasse, Estimation of RME ,Deer & RME (Mittal), Imbibition % cane, Imbibition % fibre, dilution indicator.

**Unit – III** **12 Hours**

**Sugar balance and its losses** – Estimation of sugar losses –bagasse/filter cake/molasses/ recovery/ unknown, Estimation of Pol balance, RS balance and total losses.

**Unit – IV** **12 Hours**

Available sugar / available molasses, General stock taking,Reduced boiling house control, **Boiling** house recovery, Reduced BHR, Purity drop, % exhaustion, Massecuite % cane, Steam % cane.

**Unit – V** **12 Hours**

**Overall:** Preparation of daily manufacturing report (DMR), RT(8)C,RT(7)C.

## SEMESTER II

Course code: **20SS208P**

Course: **SUGAR SCIENCE & TECHNOLOGY-PRACTICALS-IIB**

**Total Hours : 45 hours**

**Teaching Hours / week:3 Hours**

**Credits – 1**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Analysis of various chemicals used in sugar industry

- a. Lime
- b. Phosphoric acid
- c. Mill sanitation chemicals
- d. Antiscalents
- e. Sulphur
- f. Caustic Soda
- g. Hydrogen peroxide

2. Analysis of clear juice /syrup for estimation of

- a. Apparent pol %
- b. Sucrose % by double polarization
- c. TRS %.

### **Reference Books:**

1. Training manual for sugar mills.; Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
2. Efficient Management of sugar factories, Mangal Singh, Somaiya publication Pvt.Ltd. Bombay
3. Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
4. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.

**THE COURSE STRUCTURE AND SYLLABUS OF  
UNDER GRADUATE**

**III - SEMESTER**

**Academic Year 2021-22**

## SEMESTER – III

Sl. No	Course code	Name of course	Teaching hours	Duration of Exam	Marks			Credits
					IA	Exam	Total	
1		English	4	3	20	80	100	3
2		MIL	4	3	20	80	100	3
3	<b>SEC</b>	Skill Enhancement Course Personality Development and Communication Skills 20SS309T	2	2	10	40	50	2
4	<b>C7 T</b>	Chemistry– III, 20SS303T	4	3	20	80	100	3
5	<b>C7 P</b>	Chemistry Practical – III, 20SS304P	3	3	10	40	50	1
6	<b>C8 T</b>	<b>SST– IIIA</b> , (Crystallization), 20SS305T	4	3	20	80	100	3
7	<b>C8 P</b>	<b>SST–III A</b> , Practical, 20SS306P	3	3	10	40	50	1
8	<b>C9 T</b>	<b>SST– III B</b> , (Sugar Mill Analytical Control), 20SS307T	4	3	20	80	100	3
9	<b>C9 P</b>	<b>SST–III B</b> , Practical, 20SS308P	3	3	10	40	50	1
10	<b>CC/EA</b>	<b>CC/EA</b>			50	-	50	1
<b>TOTAL</b>								<b>21</b>

Total teaching hours per week: 31

Total credits in semester: 21

\*Sugar Science & Technology – SST

T: Theory, P: Practical, CC/EA: Co-Curricular/Extension Activities, SEC: Skill Enhancement Course.



## **III SEMESTER**

**Course code: 20SS309T**

**Course: Personality Development and Communication Skills**

**Total Teaching Hours : 30 hours**

**Credits – 2**

**Teaching Hours / week: 2 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

**Meaning and definition of personality: 08 Hours**

Personality development as a process , Importance of pass, Importance of personality development , Theories of Personality , Psychological theory(Signed Freud),Phenomenological theory (car Rogers) Cognitive theory (George A Kelly) A trait factor – Analytic approach(Raymond B. Cattel), Psychosocial development theory(Erickson).

**Determinants of Personality: 6 Hours**

Physical , intellectual , Emotional , social , educational familial.

**The self Concept: 6 Hours**

Individual as a self sculptor , process of perception cognition and their impact , Learning process, What is attitude, The process of attitude formation.

**Communication and its importance: 6 Hours**

Process of Communication, written and oral communication, process of listening body language or non verbal communication, the art of public speaking.

**Leadership as a process: 04 Hours**

Working in a team , management of conflict , interpersonal and intrapersonal intergroup , Profiles of great personalities , Career planning and role of career planning and role of career planning in personality development , How to face personal interview and group discussion.

**Reference:**

1. Cloninger, susan C,(2000) Theories of personality, prentice Hall London.
2. Eriksen Karin(1979) Communication skills for human services ,Prentice – Hall.
3. Hurloack, Elizabeth B(?) Personality Development.
4. Johnson Roy Ivan (1956) Communication : Handling Idea Effectivley , McGraw Hill, New York.
5. Kagan Jerome (1969), Personality Development , Harcourt Brace, New yark.
6. Kundu C.L.(1989) Personality Development , Sterling Bangalore.

## **SEMESTER III**

**Course code: 20SS303T**

**Course: CHEMISTRY - III**

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

### **INORGANIC CHEMISTRY**

#### **UNIT-I**

**10 hours**

##### **Metallurgy**

Review of steps involved in metallurgical process, thermodynamic concepts of selection of reducing agents using Ellingham diagrams, relative efficiency of carbon and carbon monoxide as reducing agent.

Reducing agents for Chromic oxide and zinc oxide.

Extraction of nickel by Mond's process, lead by carbon reduction process, aluminum from bauxite.

Powder metallurgy – Production of tungsten powder from wolframite.

#### **UNIT-II**

**5 hours**

##### **Solvents**

Types, properties of good solvents, non-aqueous solvents – liquid NH<sub>3</sub> and liquid HF, (Properties like solvation, acid-base, redox, complex formation and precipitation), water as universal solvent, levelling effect.

#### **UNIT-III**

**5 hours**

##### **Acids and Bases**

Arrhenius, Bronsted-Lowry, Lux-Flood, solvent system and Lewis concepts of acids and bases. Hard and soft acids and bases (HSAB) – classification of acids and bases as hard as hard and soft, Pearson's HSAB concept.

## **ORGANIC CHEMISTRY**

### **Unit-I**

**05 Hours**

#### **Amino acids, peptides and Proteins**

Classification, structure and stereochemistry (D and L) of amino acids acid-base behaviour, iso-electric point and electrophoresis, peptide-nomenclature and structure of peptides, synthesis of a dipeptide (Bergmann synthesis), classification of proteins, levels of protein structure (Primary, secondary and tertiary structure), protein denaturation and renaturation.

### **UNIT-II**

**5 hours**

#### **Alcohols**

Introduction and nomenclature of dihydric and trihydric alcohols, preparation of glycol from ethane, oxidative cleavage of ethylene glycol with lead tetra acetate and per iodide, pinacol-pinacolone rearrangement, preparation of glycerol from propene, synthesis and uses of nitroglycerine, composition and uses of dynamite and cordite, distinction between primary, secondary and tertiary alcohols by Lucas reagent.

### **UNIT-IV**

**5 hours**

#### **Phenols**

Classification and nomenclature, acidic character of phenol compared to alcohol and cyclohexenol, mechanism of Fries rearrangement, Claisen rearrangement, Elbs persulphate oxidation and Lederer-Manasse reaction, synthesis and uses of n-hexyl resorcinol and picric acid, structure and uses of Dettol.

### **UNIT-V**

**5 hours**

#### **Infrared spectroscopy**

Principle, types of vibrations, identification of following organic compounds by stretching frequencies-Alkanes, alkenes, alkynes, benzene, aldehydes, ketone, alcohol, thiols, acids, esters, amines, problems based on molecular formula and stretching frequency.

## **PHYSICAL CHEMISTRY**

### **UNIT-I**

**10 hours**

#### **Colligative properties**

Raoult's law, concept of lowering of vapour pressure, elevation of boiling point, depression in freezing point and osmotic pressure, derivation of  $K_b$  and  $K_f$  by thermodynamic treatment, experimental determination of molecular weight by – Landsberger's method, Beckmann's method, Berkely and Hartley method. Numerical problems.

### **UNIT-II**

**10 hours**

#### **Second law of thermodynamics**

Statement, cyclic process, Carnot's cycle, heat engine and its efficiency, Carnot's theorem, entropy and its significance, entropy changes in reversible and irreversible process for ideal gases, free energy dependence of free energy on pressure and temperature, Gibb's – Helmholtz equation, Clausius-Clapeyron equation and its applications, problems on above, partial molal quantities, chemical potential of an ideal gas.

## SEMESTER III

Course code: 20SS304P

Course: CHEMISTRY PRACTICAL - III

Total Hours : 45 hours

Credits – 1

Teaching Hours / week:3 Hours

Max. Marks: 50

Marks: Theory- 40+IA-10

### A. Physical Chemistry Experiments (Non-instrumental)

1. To study the effect of acid strength on hydrolysis of methyl acetate using HCL and  $H_2SO_4$ .
2. a) To determine the rate constant of second order reaction  $KI+K_2S_2O_8(a=b)$   
b) Effect of concentration on rate constant of second order reaction.
3. Adsorption of acetic acid on animal charcoal.
4. a) determination of surface tension and parachor of benzene series.  
b) determination of surface tension and parachor of alcohol series.
5. Determination of viscosity of liquids of Ostwald's method.
6. Determination of viscosity of binary liquid mixtures and finding the percentage composition unknown.
7. To study distribution of iodine or benzoic acid between water and benzene.
8. Determination of equilibrium constant of distribution of iodine between KI and  $CCl_4$ .
9. Determination of molecular weight of urea by Landburgers method.
10. Determination of degree of dissociation of KCL by Landburgers method.

## REFERENCE BOOKS

### Books recommended for physical chemistry :

1. Physical Chemistry : Puri and Sharma
2. Physical Chemistry : P.L. Soni
3. Physical Chemistry : Roberty A. Alberty
4. Physical Chemistry : M.V.Sangaranarayanan and V. Mahadevan
5. Physical Chemistry : Atkins
6. Physical Chemistry : Bahl, Madan and Tuli

### Reference books for inorganic chemistry

1. Advanced Inorganic Chemistry Gurdeep Raj.
2. Basic Inorganic Chemistry Alber Cotton and Wilkinson.
3. Inorganic Chemistry James Huheey.
4. Modern Inorganic Chemistry R.D.Madan
5. Inorganic Chemistry J.D.Lee .

### Books recommended for organic chemistry :

1. Organic Spectroscopy : P.S.Kalsi
2. Organic Spectroscopy : Y. R. Sharma
3. Organic Chemistry : I. L. Finar, Vol-I
4. Synthetic Organic Chemistry : Gurudeep Chatwal

## SEMESTER III

Course code: 20SS305T

### SUGAR SCIENCE & TECHNOLOGY-III A

Course: CRYSTALLIZATION

**Total Teaching Hours : 60 hours**

**Teaching Hours / week: 4 Hours**

**Credits – 3**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

#### **Unit – I**

**12 Hours**

**Syrup treatment & General pan boiling concepts:** Syrup treatment, continuous syrup sulphiter, reasons for syrup sulphitation, Definitions of various technical term – syrup/massecuite/mother liquor/molasses/magma/seed/grain/ slurry/cutting/footing/, Solubility of sugar in water, concept of super saturation, Different zones of super saturation, Classen’s theory of Pan Boiling, Aims of pan boiling, techniques of pan boiling

#### **Unit – II**

**12 Hours**

**Vacuum pan & accessories:** General construction of Batch type low head pan & its working, various accessories of vacuum pan , Different types of batch type calandria pans, central flow; peripheral and side flow, different types of calandria-their advantages and disadvantages, General construction of horizontal continuous vacuum pan

#### **Unit – III**

**12 Hours**

**Massecuite boiling Practices:** High grade massecuite boiling practice: Starting of pan, Pan washing, Introduction of material in pans, Footing /Graining practice, Washing of footing, , 2A pan strikes concept, Pan cutting, Single pan boiling, pan tightening, vacuum boiling, vacuum braking, pan discharging and related operations



**Unit – IV****12 Hours**

**Different massecuite boiling schemes :** 4 Massecuite, 3 massecuite & 3 ½ massecuites boiling, Various formulae's for - % exhaustion/ Crystal content/ purity drop , Cobenz diagram & Estimation of molasses /sugar quantity by using Cobenz diagram

**Unit – V****12 Hours**

**Low grade (B & C)massecuite boiling practice:** Starting of pan, Pan washing, Introduction of material in pans, Concentration of graining material, Tests for slurry dosing, graining practice, Slurry dosing, Grain control, Grain washing, Grain filling , 2B/2C pan strikes concept, Pan cutting, Single pan boiling, pan tightening, vacuum boiling, vacuum braking, pan discharging and related operations

**Semester III**  
**Course code: 20SS306P**  
**Course: SUGAR SCIENCE & TECHNOLOGY-PRACTICAL-III**

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Analysis of massecuite for brix, pol purity and non-sugar
2. Analysis of massecuite & molasses for purity drop, % exhaustion & crystal content
3. Nutch molasses sample collection & analysis for Brix % & Purity
4. Sugar analysis for different grades as per Indian standard
5. Crystal size analysis and estimation of MA & CV
6. Analysis of sugar sample for
  - ICUMSA colour,
  - Pol %,
  - Moisture %,
  - Conductivity Ash %,
  - Reducing Sugar % ,
  - Dextran content,
  - Starch content,
  - Polyphenol content,
  - SO<sub>2</sub> content
7. Estimation of saturation temperature of massecuite by using Saturoscope.

**REFERENCE BOOKS:**

1. Principles of sugar technology, Honig Pieter, Elsevier publishing company Amsterdam
2. Hand book of Cane Sugar Engineering, Hugot e., Elsevier Science publishing Co.Inc. New York.
3. Notes for Sugar crystallisation By Dr. M. B. Londhe, VSI Pune
4. Sugar Technology for Administrators in the Indian sugar factories; Manohar Rao,P.J.; Jayajirao Shinde Editor Bharatiya Sugar Jeevan Darshan Laxmi Rd. Pune.
5. Training manual for sugar mills. Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
6. Efficient Management of sugar factories, Mangal Singh, Somaiya publication Pvt.Ltd. Bombay
7. Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
8. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
9. Hand book of Cane Sugar Technology, Mathur R.B.L., Oxford DBH publishing Co.N.Delhi.

**SEMESTER III**  
**Course code: 20SS307T**  
**Course: SUGAR SCIENCE & TECHNOLOGY-IIIB**  
**SUGAR MILL ANALYTICAL CONTROL**

**Total Teaching Hours : 60 hours**  
**Teaching Hours / week: 4 Hours**

**Credits – 3**  
**Max. Marks: 100**  
**Marks: Theory- 80+IA-20**

**Unit – I** **12Hours**

**Sugar Cane:** Different methods for direct analysis of cane for pol & fiber

**Unit – II** **12 Hours**

**Milling control:** Methods for estimation of preparatory index, Extraneous matter, Primary extraction – Pol base & juice base, Brix curve, Individual mill extraction, Mill test, Mill performance assessment.

**Unit – III** **12 Hours**

**Juice clarification & Evaporator control** – Estimation of evaporation rate from brix samples, Efficiency measurement at juice clarification – CaO rise, Colour removal, Turbidity removal, RS balance study , Purity rise.

**Unit – IV** **12 Hours**

**Pan boiling control:** Purity drop, % exhaustion, RS balance, Brix balance, NS balance calculations, Actual to theoretical Molasses % cane, Sugar grades etc

**Unit – V** **12 Hours**

**Overall:** steam % cane, Total losses, Unknown sugar loss estimation, Solid balance, stock taking, Sugar gradation,

**Semester III**  
**Course code: 20SS308P**  
**Course: Sugar Science & Technology-Practical-IIIB**

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Estimation of brix curve
2. Analysis of prepared cane for preparatory index
3. Analysis of primary extraction or crusher extraction– Pol base & juice base
4. RS/ 100 Brix and RS balance study of boiling house products – Samples – PJ/MJ/Clear Juice/Syrup/Molasses
5. Analysis of spray water for pH / TDS / Sugar test.
6. Analysis of dextran in clear juice by using spectrophotometers.
7. Determination of poly phenols by Spectrophotometers
8. Analysis of sugar for CV & MA as ICUMSA method.

## **REFERENCE BOOKS:**

1. Principles of sugar technology, Honig Pieter, Elsevier publishing company Amsterdam
2. Hand book of Cane Sugar Engineering, Hugot e., Elsevier Science publishing Co.Inc. New York.
3. Notes for Sugar crystallisation By Dr. M. B. Londhe, VSI Pune
4. Sugar Technology for Administrators in the Indian sugar factories; Manohar Rao,P.J.; Jayajirao Shinde Editor Bharatiya Sugar Jeevan Darshan Laxmi Rd. Pune.
5. Training manual for sugar mills. Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
6. Efficient Management of sugar factories, Mangal Singh, Somaiya publication Pvt.Ltd. Bombay
7. Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
8. System of Technical control for -cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
9. Hand book of Cane Sugar Technology, Mathur R.B.L., Oxford DBH publishing Co.N.Delhi.

**THE COURSE STRUCTURE AND SYLLABUS OF  
UNDER GRADUATE**

**IV - SEMESTER**

**Academic Year 2021-22**

## SEMESTER – IV

Sl. No	Course code	Name of course	Teaching hours	Duration of Exam	Marks			Credits
					IA	Exam	Total	
1		English	4	3	20	80	100	3
2		MIL	4	3	20	80	100	3
3	SEC	Skill Enhancement Computer Applications 20SS409T	2	2	10	40	50	2
4	C10T	Chemistry – IV 20SS403T	4	3	20	80	100	3
5	C10 P	Chemistry Practical – IV, 20SS404P	3	3	10	40	50	1
6	C11 T	SST– IV A, (Analytical Instrumentation) 20SS405T	4	3	20	80	100	3
7	C11 P	SST– IV A, Practicals, 20SS406P	3	3	10	40	50	1
8	C12T	SST–IV B (Fermentation and distillation Technology), 20SS407T	4	3	20	80	100	3
9	C12 P	SST–IV B Practical, 20SS408P	3	3	10	40	50	1
10	CC/EA	CC/EA			50	-	50	1
<b>TOTAL</b>								<b>21</b>

Total teaching hours per week: 31

Total credits in semester: 21

\*Sugar Science & Technology – SST

T: Theory, P: Practical, CC/EA: Co-Curricular/Extension Activities, SEC: Skill Enhancement Course.



**Semester IV**  
**Course code: 20SS409T**  
**Course: Computer Applications**

**Total Teaching Hours : 30 hours**

**Credits – 2**

**Teaching Hours / week: 2 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

**UNIT I**

**8 Hours**

**Introduction:** Computer, data processing, characteristic features of computers, computer evolution to present form, computer generation. **Basic computer organization:** Basic operations performed by computers, basic organization of computer system, input units and its functions, output units and its functions, storage units and its functions, types of storage.

**Number systems:** non-positional number system, positional number system, decimal, binary, octal, and hexadecimal number systems. Conversion from decimal to binary and vice-versa for integer numbers only.

**Computer Codes:** Computer data, computer codes: representation of data in binary, commonly used computer codes, collating sequence

**UNIT II**

**8 Hours**

**Processor and memory:** Internal structure of processor, memory structure, types of processors, main memory organization, random access memory, read only memory, cache memory.

**Secondary storage:** secondary storage devices and their needs, commonly used secondary storage devices, sequential and direct access storage devices, basic principles of commonly used secondary storage devices (magnetic disk, optical disk, flash drives, memory card, disk array).

**IO devices:** commonly used input output(IO) devices.

### **UNIT III**

**8 Hours**

**Software:** Software and its relationship with hardware, types of softwares, relationship among hardware, system software, application software and users of computer systems, steps involved in software development, firmware, middle ware. Overview of operating system: Definition, functions of operating system, concept of multi programming, multitasking, multithreading, multiprocessing, time-sharing, real time, single user& multi-user operating system.

### **UNIT IV**

**6 Hours**

#### **The Internet:**

What is the Internet?, The Internet Defined, Internet History, The Way the Internet Works, Internet Congestion, Internet Culture, Business Culture and the Internet, Collaborative Computing and the Internet.

#### **The World Wide Web:**

The World Wide Web Defined, Web Browser Details, Web Writing Styles, Web Presentation Outline, Design, and Management, Registering Web Pages, Lynx: Text-Based Web Browser. Searching the World Wide Web: Directories, Search Engines, and Meta search Engines, Search Fundamentals, Search Strategies. Telnet and FTP: Telnet and Remote Login, File Transfer, Computer Viruses.

**References:**

1. P. K. Sinha and Priti Sinha, Computer Fundamentals, Sixth Edition, BPB publications.
2. Rajaraman V., Introduction to Information Technology, 2nd Edition, PHI
3. S. K. Basandra, Computers Today ,Galgotia Publications.
4. Xavier, C “Introduction to Computers and Basic Programming” New age International.
5. Rajaraman, V., Adabala, Neeharika, Fundamentals of Computers, PHI
6. Raymond Greenlaw, , Ellen Hepp, Inline/Online: Fundamentals of the Internet and the WorldWide Web, 2/e, McGraw Hill Education;
7. Dietil and Dietil, Nieto, Internet and world wide web programming, Pearson Education
8. Sai Satish, Yash Patel, Srinivas Rao, LokeshReddy, Exploring Internet, Jai Sharma, IndianServers
9. Gill, Nasib Singh: Essentials of Computer and Network Technology, Khanna Books PublishingCo., New Delhi
10. Norton, Peter, Introduction to Computer, McGraw-Hill.

## **SEMESTER IV**

**Course code: 20SS403T**

**Course: CHEMISTRY - IV**

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

### **INORGANIC CHEMISTRY**

#### **UNIT-I**

##### **Organometallic compounds**

**5 Hours**

Synthesis of methyl magnesium iodide and its synthetic applications in the preparation of alcohols (primary, secondary and tertiary) aldehyde, ketone, ester, carboxylic acid, amines and alkanes.

Organo-lithium compounds: Preparation of Lithium dialkylcuprate and synthesis of higher alkane from it.

#### **UNIT-II**

##### **Bioinorganic Chemistry**

**5 Hours**

Essential and trace elements in biological process, metalloporphyrins with respect to haemoglobin and chlorophyll (structure and function), biological role of Na, K, Fe and Zn.

#### **UNIT-III**

##### **Environmental Chemistry**

**10 Hours**

**Air pollution** :Types of pollutants, sources and control measures-Co, Co<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub>, H<sub>2</sub>S, hydrocarbons, CFC's and particulates, pesticides, and their adverse effects.

**Water pollution :** Types of pollutants, sources and adverse effects (sewage, infectious agents, organic chemicals and inorganic mineral, oils and sediments)

Parameters of water pollution – Dissolved oxygen (DO), biological oxygen demand (BOD) and chemical oxygen demand (COD), definitions and their determinations. Treatment of sewage and industrial effluents – Preliminary, primary and secondary treatment (Aerated lagoons, trickling filters and activated sludge)

## **ORGANIC CHEMISTRY**

### **UNIT-I Aldehydes and Ketones**

**6 Hours**

Nomenclature, structure and Bonding, mechanism of nucleophilic addition reactions-Hydrogen cyanide, hydroxyl amine, acetal formation – with ethanol and ethylene glycol.

Mechanism of the following reactions :

- a) Aldol condensation
- b) Cannizzaro's reaction
- c) Claisen-Schmidt reaction
- d) Perkin's reaction
- e) Benzoin condensation
- f) Baeyer – Villiger oxidation of ketones
- g) Mannich reaction, Synthesis of Coumarin and Vanillin.

### **UNIT-II Carboxylic Acids**

**6 Hours**

Nomenclature, structure and bonding, acid strengths of mono, di and trichloroacetic acids, and nitro, chloro and hydroxyl substituted benzoic acids, mechanism of esterification and hydrolysis of ester ( $A_{AC}^2$  and  $B_{AC}^2$ ).

Reactions of carboxylic acids –i) Conversion into acid derivatives (acid chlorides, amides, esters and anhydrides), ii) Curtius rearrangement, iii) Reaction with organometallic compounds and iv) Hell-Volhard-Zelinsky reaction.

**Vitamins:****5 Hours**

Vitamins: Classification and importance of vitamin-A, B<sub>6</sub>, B<sub>12</sub>, C, D, and E. Synthesis of vitamin –C from D(+)-glucose, synthesis of vitamin–A by vandropetal.

**UNIT-IV****Ethers and Epoxides****5 Hours**

**Ethers** : Nomenclature of ethers and their methods of preparation chemical reactions – Reaction with HI, hot and cold taking symmetric and unsymmetrical ethers.

**Crow ethers** : Definition, examples, use of crown ethers as phase transfer catalysts.

**Epoxides** : Synthesis of 1,2-epoxy ethane and 1,2-epoxycyclopentane, acid catalysed ring opening of 1,2-epoxycyclopentane in aqueous solution.

## PHYSICAL CHEMISTRY

### UNIT-I Electrochemistry

9 hours

Debye-Huckel's theory, Debye-Huckel equation for strong electrolytes (no derivation).

Applications of conductance measurements)

- a) Determination of solubility product of sparingly soluble salts.
- b) Conductometric titrations, types of acid – base titrations and precipitation titrations.
- c) Determination of degree of dissociation of weak electrolytes ionic mobility, transport number and its determination by Hittorff's method.

### UNIT-II Chemical Kinetics

9 hours

Second order reaction with examples, derivation of rate constant equation of second order reaction when concentration of the reactants are equal ( $a=b$ ), half life period, determination of order of reaction by a) Differential equation method b) Half life method.

**Simple collision theory of reaction rates :** Derivation of rate constants of unimolecular (Lindemann hypothesis) and bimolecular reaction rates, limitations of collision theory.

Transition state theory : Theory

Comparison of transition state theory and collision theory, steric factor, Chemical kinetics of complex reactions-first order reaction, opposing consecutive and parallel reactions.



## SEMESTER IV

Course code: 20SS404P

Course: CHEMISTRY PRACTICAL - IV

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Semi-micro Qualitative analysis of two simple inorganic salts

ANIONS :  $\text{CO}_3^{-2}$ ,  $\text{S}^{-2}$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{-2}$

CATIONS :  $\text{Pb}^{+2}$ ,  $\text{Cu}^{+2}$ ,  $\text{Al}^{+3}$ ,  $\text{Fe}^{+2}$ ,  $\text{Fe}^{+3}$ ,  $\text{Mn}^{+2}$ ,  $\text{Co}^{+2}$ ,  $\text{Ni}^{+2}$ ,  $\text{Ca}^{+2}$ ,  $\text{Ba}^{+2}$ ,  
 $\text{Mg}^{+2}$ ,  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{NH}_4^+$ .

2. Determination of dissolved oxygen present in water by Winkler's method.
3. Determination of C.O.D in polluted water.

## REFERENCE BOOKS

### Book recommended for physical chemistry :

01. Physical Chemistry : Puri and Sharma
02. Physical Chemistry : P.L. Soni
03. Physical Chemistry : Roberty A. Alberty
04. Physical Chemistry : M. V. Sangaranarayanan And V. Mahadevan
05. Physical Chemistry : Atkins
06. Physical Chemistry : Bahl, Madan and Tuli

### Reference books for inorganic chemistry

01. Advanced Inorganic Chemistry : Gurdeep Raj
02. Basic Inorganic Chemistry : Alber Cotton and Wilkinson
03. Inorganic Chemistry : James Huheey
04. Modern Inorganic Chemistry : D. Madan
05. Inorganic Chemistry : J.D. Lee
06. Environmental Chemistry : A.K.Dey
07. Environmental Chemistry : H. Kour

### Books recommended for organic chemistry:

01. Organic Chemistry Wade
02. Organic Chemistry I.L. Finar Vol-I
03. Organic Chemistry Morrison and Boyd
04. Organic Chemistry Bahl and Tuli
05. Organic Chemistry Bahl and Arun Bahl

## SEMESTER IV

Course code: 20SS405T

### Course: SUGAR SCIENCE & TECHNOLOGY-IVA ANALYTICAL INSTRUMENTATION

**Total Teaching Hours : 60 hours**  
**Teaching Hours / week: 4 Hours**

**Credits – 3**  
**Max. Marks: 100**  
**Marks: Theory- 80+IA-20**

**Unit – I** **12 Hours**

**Spectroscopy:** General principles of absorption spectroscopy, theory of Colorimetry, Beers & Lambert Law, Instrumentation of Photoelectric Colorimeter, construction of standard curve and applications.

**Flame Photometry:** General discussion and elementary theory, Instrumentation of flames photometer, monochromators, detectors and applications

**Unit – II** **12 Hours**

**Polarimetry:** Introduction, plane polarized light, optical activity, Instrumentation of Polarimeter, types of polarimeter, Laurent polarimeter, Industrial polarimeter, white lamp single wedge and double wedge polarimeter, automatic polarimeter, measurement of specific rotation and determination of unknown concentration and other applications in sugar technology.

**Unit – III** **12 Hours**

**Refractometry:** Introduction, Snell's law, specific refraction, molar refraction, Hand Refractometer, Abbe's Refractometer, experimental techniques and applications.

**Unit – IV** **12 Hours**

**pH and Conductivity measurements:** Introduction sensors, Electroanalytical Sensors, different types of sensor electrodes, pH meter, standardization and pH measurements, conductivity solutions, specific and equivalent conductivity,

equivalent conductivity at infinite dilution, measurement of conductivity/resistivity of solution, Conductometers, conductivity cell applications.

Laboratory equipment calibration process – Brix hydrometer, Thermometer, weight box, lab oven, Polarimeter, Refractometer, pH meter, conductivity meter, TDS meter, spectrophotometer

### **Unit – V**

**12 Hours**

**Chromatography:** Introduction, Classification of chromatographic methods, introduction of terms used in chromatography,

Thin layer chromatography: Introduction of basic concept and technique, methodology, application,

Gas chromatography: General introduction of terminology, stationary phases, supports used for making GLC column

## **Semester IV**

**Course code: 20SS406P**

**Course: SUGAR SCIENCE & TECHNOLOGY-PRACTICAL-IVA**

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Measurement of angle of rotation on automatic polarimeter
2. To find viscosity of juice by viscometer
3. To find viscosity of syrup by viscometer
4. To study operations of spectrophotometer
5. To determine refractive index of juice /syrups/sugar solution by using abbe refractomat
6. To study refractometer instrument
7. To study GLC instrument
8. To study digital pH meter
9. To study brix hydrometer
- 10.To study conductivity meter
- 11.To study flame photometer

### **REFERENCE BOOKS:**

1. Vogel's Textbook of quantitative inorganic revised by J. Bassett et al.
2. Instrumental Methods of Chemical Analysis by H. Kaur.
3. Instrumental methods of analysis by Strobel.
4. Practical Physical Chemistry by Findley.
5. Instrumental methods of chemical analysis by Bhal and Tuli.

## SEMESTER IV

Course code: 20SS407T

Course: SUGAR SCIENCE & TECHNOLOGY-IVB

### FERMENTATION & DISTILLATION TECHNOLOGY

Total Teaching Hours : 60 hours

Credits – 3

Teaching Hours / week: 4 Hours

Max. Marks: 100

Marks: Theory- 80+IA-20

#### Unit – I

10 Hours

**Cane Molasses:** Composition of final molasses, Grades of molasses, General quality standards for final molasses – Brix % /Purity/Ash %/ TRS %/ Fermentable Sugar/ un-fermentable sugar, Storage of final molasses, Factors responsible for reducing the F/N ratio of molasses.

Definitions & concepts of Molasses , Total reducing sugar, Fermentable sugar , un-fermentable Sugar, Residual Sugar, Wort, Brix, Specific Gravity, Distillation, Industrial Alcohol, Proof Spirit, Strength of Spirit, Reflux, Vaporization, Sachharification, Scaling, Scrubber, Starch Sucrose rectification, Geletinization, liquefaction, Reboiler, Under proof, Over proof

#### Unit – II

10 Hours

**Applied Microbiology:** Definition of yeast, Taxonomy of yeast, Morphology of yeast, type of micro-organism, common strains of yeast used for alcoholic fermentation, Growth requirement of yeast, Yeast structure and function of cellular components, Metabolic path way of yeast, Alcoholic pathway, Glycolysis of EMP path way, Citric acid cycle

#### Unit – III

10 Hours

**Fermentor:** Definition & type of fermentor, Traditional batch, fed-batch & continuous fermentation, Difference between batch and continuous

fermentation, design of fermenters-some extracts from text books, Fermentation of molasses /juice/syrup

**Unit – IV**

**12 Hours**

**Yeast :** 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 Yeast growth (aerobic & Anaerobic), Crab tree effect, Growth Kinetics, Significance of growth curve, lag phase, Log phase, stationary phase, death phase etc, Propagation phase & aspartic condition  
Speed study of *Sachrongescirncia*&*SacharomycesPombe* and alcohol tolerance, Gravity tolerance limit

**Unit – V**

**10 Hours**

**Distillation:** Types of distillation process, Atmospheric distillation, MPR distillation, MPR distillation benefits, RS & ENA production from molasses, Production of unhydrous alcohol from RS with dehydration with molecular sieve process & membrane process

**Distillation equipment's:** Columns- its design & construction, Maintenance of columns, Types of tray, types of condensers, Types of reboilers

**Unit – VI**

**8 Hours**

2G – Ethanol, Ethanol production from multiple feed stocks containing cellulose – Grains / Bagasse

## SEMESTER IV

Course code: 20SS408P

Course: SUGAR SCIENCE & TECHNOLOGY-PRACTICAL-IVB

Total Hours : 45 hours

Teaching Hours / week:3 Hours

Credits – 1

Max. Marks: 50

Marks: Theory- 40+IA-10

1. Microscopic examination of microorganisms like bacteria, yeast, fungi etc.
2. Preparation and sterilization of culture media like nutrient agar medium, malt extract medium, molasses agar medium etc., preparation of slants and stabs.
3. Acquaintance with different microbiological techniques like inoculation, streaking, plating etc., aseptic handling of culture media and pure cultures.
4. Isolation and development of a pure yeast culture
5. Preparation of bacterial culture slides and staining by Gram stain.
6. Dilution and plating of culture for total viable cell count.
7. Differential counting of living and dead yeast cells by direct microscopic examination.
8. Determination of total solids and suspended solids of molasses
9. Determination of nitrogen content by Kjeldahl's method
10. Determination of alcohol content by slices hydrometer
11. Determination of fermentable & unfermentable sugars in molasses
12. Determination of total organic volatile acids in molasses & fermentation broth sample.
13. Determination of total & fixed volatile acidity of spirit (ISI method).
14. Determination of aldehyde content of Spirit (AOAC Method).
15. Determination of fusel oil & furfural content in spirit sample.
16. To conduct potassium permanganate test for finding the quality of spirit
17. Analysis of B heavy molasses for – TDS/Fermentable Sugar / VA



**REFERENCE BOOKS:**

1. Industrial Alcohol technology Handbook, NPCS board of consultant & Engineer
2. Hand book of Alcohol Technology By S. V. Patil
3. Sugar Technology for Administrators in the Indian sugar factories; ManoharRao,P.J.; JayajiraoShinde Editor Bharatiya Sugar JeevanDarshanLaxmi Rd. Pune.
4. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
5. Industrial utilization of sugar cane and its Co-products , Manohar Rao, P.J., ISPCK publishers & Distributors N.Delhi
6. Alcohol Technology By Muthag, Vth eddition

**THE COURSE STRUCTURE AND SYLLABUS OF  
UNDER GRADUATE**

**V - SEMESTER**

**Academic Year 2022-23**

## SEMESTER – V

Sl. No	Course code	Name of course	Teaching hours	Duration of Exam	Marks			Credits
					IA	Exam	Total	
1	SEC	Skill Enhancement Course Analytical Chemistry for Industrial Application 20SS519T	2	2	10	40	50	2
2	DSC1 T	Chemistry- V A 20SS501T	4	3	20	80	100	3
	A OR B	SST–V A, (Sugar Equipments Design) 20SS503T SST–V B, (Sugar Mill – Water Management & Effluent Treatment) 20SS505T	4	3	20	80	100	3
3	DSC1 P	Chemistry Practical V A 20SS502P	3	3	10	40	50	1
	A OR B	SST V A–Practical, 20SS504P SST– V B- Practical, 20SS506P	3	3	10	40	50	1
4	DSC2 T	Chemistry – V B , 20SS507T	4	3	20	80	100	3
	A OR B	SST–V C (Sugar Instrumentation) 20SS509T SST–V D, (Specialty Sugar Technology) 20SS511T	4	3	20	80	100	3
5	DSC2 P	Chemistry Practical– V B, 20SS508P	3	3	10	40	50	1
	A OR B	SST– V C, Practical, 20SS510P SST– V D, Practical, 20SS512P	3	3	10	40	50	1
6	DSC3 T	SST– V E, (Centrifugation), 18SS513T	4	3	20	80	100	3
	A OR B	SST–V F, Industrial Statistics (Self-study)- 20SS514T SST–V G, (Distillery)	4	3	20	80	100	3

		Effluent Treatment Technology) 20SS515T							
7	<b>DSC3 P</b>	<b>SST– V H</b> , Industrial visit (Overhauling practices) report 20SS517P			50	-	50	1	
	A OR B	<b>SST–V I</b> , Sugar Complex economics study report (self-Learning) 20SS518P			50	-	50	1	
		<b>OR</b>							
		<b>SST– V G–Practical</b> , 20SS516P	3	3	10	40	50		
<b>TOTAL</b>								<b>26</b>	

Total credits in semester: 26

\*Sugar Science & Technology – SST

## SEMESTER V

Course code: 20SS519T

### SKILL ENHANCEMENT COURSE

#### ANALYTICAL CHEMISTRY FOR INDUSTRIAL APPLICATION

**Total Teaching Hours : 30 hours**

**Credits – 2**

**Teaching Hours / week: 2 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

**30 Hours**

#### **Introduction:**

Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

**Analysis of soil:** Composition of soil, Concept of pH and pH measurement, complexometric titrations, Chelation, Chelating agents, use of indicators. Determination of pH of soil samples. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

**Nutrients:** Macro and Micro nutrients of soils.

**Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. Determination of pH, acidity and alkalinity of a water samples. Determination of dissolved oxygen (DO) of a water sample.

**Analysis of food products:** Nutritional value of foods, idea about food processing and adulteration. Identification of adulterants in some common food

items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. Analysis of preservatives and colouring matter.

#### **REFERENCE BOOKS:**

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7<sup>th</sup> Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
2. Skoog. D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
3. Skoog. D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6<sup>th</sup> Ed., Saunders College Publishing, Fort Worth (1992).
4. Harris, D.C. Quantitative Chemical Analysis, W.H. Freeman.
5. Dean, J.A. Analytical Chemistry Notebook, McGraw Hill.
6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
7. Freifelder, D. Physical Biochemistry 2<sup>nd</sup> Ed., W.H. Freeman and Co., N.Y. USA (1982).
8. Copper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y.USA. 16(1977).
9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7<sup>th</sup> Ed., Prentice Hall.
10. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6<sup>th</sup> Ed., Prentice Hall.

**SEMESTER V**  
**Course code: 20SS501T**  
**Course: CHEMISTRY - VA**

**Total Teaching Hours : 60 hours**

**Teaching Hours / week: 4 Hours**

**Credits – 3**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

**Inorganic Chemistry**

**Coordination Chemistry-I**

**06 hours**

Review of terms: double salts, complex salts, central metal ion, ligand, types of ligands, complex ion and coordination number. IUPAC nomenclature Valence bond theory of coordination compounds with reference to  $(\text{Fe}(\text{CN})_6)^{-3}$ ,  $(\text{Fe}(\text{CN})_6)^{-4}$ ,  $[\text{FeF}_6]^{-3}$ ,  $[\text{Zn}(\text{NH}_3)_4]^{+2}$ ,  $[\text{Ni}(\text{CN})_4]^{-2}$  and its limitations.

Isomerism – Ionisation, hydrate, linkage, geometrical and optical in coordination compounds with respect to coordination number 4 and 6.

**Theory of gravimetric analysis**

**04 hours**

Principles of gravimetric analysis –super saturation, von Weimar equation, conditions of precipitation, coprecipitation and post precipitation. separation of precipitate from mother liquor, washing, properties of wash liquid, drying and ignition of precipitate, weighing form.

**Inorganic polymers**

**06 hours**

Inorganic polymers, Types, comparison with organic polymers, silicones, phosphonitrilic halides-formation, structure and applications.

**Green Chemistry**

**04 hours**

The need for green chemistry and eco-efficiency, green methods, green products, recycling of wastes, 12 principles of green chemistry.

## **Organic Chemistry:**

### **Heterocyclic Compounds**

**10 hours**

Classification, molecular orbital picture and Aromatic character of furan, thiophene, pyrrole and pyridine, synthesis of the following compounds.

- i) Furan, thiophene and pyrrole from 1,4- diketones.
- ii) Pyridine by Hantzsch synthesis

Electrophilic substitution reactions of pyrrole, Furan and pyridine (chlorination and nitration), comparison of basicities of pyridine, piperidine and pyrrole.

### **Terpenoids**

**04 Hours**

Introduction, classification of terpenes, Ingold's isoprene rule, Constitution of citral with synthesis, synthesis of alpha & Beta ionones, synthesis of alpha-terpeniol.

### **Organic Synthesis via enolates**

**06 hours**

Acidity of alpha-hydrogens, synthesis of ethylacetoacetate (EAA) by Claisen condensation and its mechanism, synthesis of diethyl malonate, keto-enol tautomerism of EAA, Synthesis of following compounds using EAA and diethyl malonate: i) ketones ii) carboxylic acids iii) heterocyclic compounds iv) dicarboxylic acids.

## **Physical Chemistry:**

### **Microwave Spectroscopy**

**08 hours**

Classification of molecules, rotational spectra of rigid diatomic molecules, criteria for showing the spectra, energy levels of rigid rotator, selection rules (final equations only), determination of bond length and moment of inertia of HCL molecule.



**Phase rule****04 hours**

Terminology and explanation of the terms involved. Applications of phase rule- One component system-water and sulphur systems Two-component systems- Bismuth-Cadmium system and KI – water system. Eutectic and freezing mixture.

**Electronic spectrum****04 Hours**

Concept potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules, energy levels and respective qualitative transitions, Frank-condon principle.

**Vibrational spectrum****04 hours**

Simple harmonic oscillator, Hooke's law, energy level of simple harmonic oscillator model of diatomic molecule (final equations only), selection rules, zero point energy determination of force constant and qualitative relation between force constant and bond dissociation energies. Vibrational degrees of freedom of molecules (Linear and non linear).

## **SEMESTER V**

**Course code: 20SS502P**

**Course: CHEMISTRY PRACTICALS – V-A**

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

### **Organic Preparations:**

- 01.Preparation of m-dinitrobenzene from nitrobenzene.
- 02.Preparation of phthalimide from phthalic anhydride and urea.
- 03.Preparation of p-bromoacetanilide from acetanilide.
- 04.Preparation of p-bromoaniline from p-bromoacetanilide.
- 05.Preparation of p-nitroacetanilide from acetanilide.
- 06.Preparation of p-nitroaniline from p-nitroacetanilide.
- 07.Preparation of Benzoic acid from benzaldehyde.
- 08.Preparation of methyl orange.

**Any one of the experiment may be given for the examination.**

## **REFERENCE BOOKS FOR INORGANIC CHEMISTRY**

1. Advance Inorganic Chemistry Vol-I and II : Gurudeep Raj
2. Advance Inorganic Chemistry : Satya Prakash
3. Modern Inorganic Chemistry : R.D.Madan
4. Inorganic Chemistry : James Huheey
5. Concise Inorganic Chemistry : J.D.Lee
6. Inorganic Chemistry : Shreiver and Atkins

## **BOOKS RECOMMENDED FOR ORGANIC CHEMISTRY**

1. Organic Chemistry : I.L.Finar Vol-1
2. Organic Chemistry : Morrison and Boyd
3. Advanced Organic Chemistry : Jerry March

## **BOOKS RECOMMENDED FOR PHYSICAL CHEMISTRY**

1. Fundamentals of Molecular Spectra : C.N.Banwell
2. Molecular Spectroscopy : S.Chandra
3. Molecular Spectroscopy : White
4. Chemical Kinetics : K.J.Laidler
5. Surface Chemistry : Gregg

## SEMESTER V

Course code: 20SS503T

B. Sc. (SUGAR SCIENCE & TECHNOLOGY)-VA

### SUGAR EQUIPMENTS DESIGN

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

#### **Unit – I**

**10 Hours**

**Juice heater** – Calculations for HS, number of tubes per pass, juice inlet/out let pipe sizes, exhaust /Vapour inlet sizes, condensate outlet sizes, condensate extraction arrangement

**Evaporator** – Calculations for HS, number of tubes, juice inlet/out let pie sizes, exhaust /Vapour inlet/outlet sizes, condensate outlet sizes, condensate extraction arrangement, vapour bleeding

#### **Unit – II**

**10 Hours**

**Vapor Bleeding System:** Use of steam table, Vapour bleeding calculations for Quadruple & quintuple effect, Dessin's formulas, Specific evaporation coefficient calculation & importance, estimation of evaporation rate based on brix data, BPR and its calculations

#### **Unit – III**

**10 Hours**

**Juice Clarification:** Juice piping sizes, Shock liming time calculation, juice sulphiter sizing, clarifier sizing, vacuum filter sizing, sulphur burner sizing

**Juice & evaporator section:** Capacity calculations for standard 5000 TCD sugar plant – raw juice to syrup

#### **Unit – IV**

**10 Hours**

**Pan & crystallizers** – Calculations for HS, number of tubes, graining volume, strike level, S/V ratio, vapour inlet /outlet, capacity calculations for crystallizers, Number of pans /Types of crystallization,low grade/ crystallizers / storage tanks required for 5000 TCD capacity.

**Cooling and Condensing**– Calculations for water requirement for condensers, number of nozzles for spray pond, spray pond layout, piping size calculations for cooling & condensing system, Idea about cooling.

**Unit – V**

**10 Hours**

**Centrifugals:** Capacity calculations for high & low grade centrifugals, Molasses & massecuite pumps calculations, Molasses storage tank capacity calculations. Different types of centrifugal machines.

**Sugar handling equipment's:** capacity calculations for sugar hopper, sugar elevator, sugar grader, sugar silo, dry seed conveying system and related accessories

**Unit – V**

**10 Hours**

Factors affecting capacity of milling tandem, Normal specs for 5000 TCD sugar plant

## **SEMESTER V**

**Course code: 20SS504P**

**B. Sc. (Sugar Science & Technology)- Practicals –VA**

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Use of various precision instruments required for workshop – Vernier caliper, Micrometer
2. Assessment of tubes used for juice heater / evaporator / vacuum pans for Tube length, ID/OD, Thickness, HS
3. Assessment of metal sheet – Size, thickness, weight of metal sheet
4. Assessment of roller – Roller Size, journal size, grooving details
5. Measurement of capacity of tanks
6. Assessment of evaporator body – Tube size, number of tubes, HS, Down take size, Calandria volume
7. Assessment of vacuum pan – Tube size, number of tubes, HS, graining volume, strike volume, total volume
8. Assessment of juice sulphiter –total volume, working volume, retention time, shock liming time

## **REFERENCE BOOKS:**

1. Principles of sugar technology, Honig Pieter, Elsevier publishing company Amsterdam
2. Hand book of Cane Sugar Engineering, Hugot e., Elsevier Science publishing Co.Inc. New York.
3. Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
4. Unit operations in cane sugar production; Payne, J.N.; Elsevier pub Co. Amsterdam.
5. Machinery and Equipment of the cane sugar factory, Tromp, L.A., Norman Rodger, 7 & 8 Idol Lane.
6. Introduction to cane Sugar Technology, Jenkins, Q.H., Elsevier scientific publishing company Amsterdam.

**SEMESTER V**  
**Course code: 20SS505T**  
**B. Sc. (SUGAR SCIENCE & TECHNOLOGY)-VB**  
**SUGAR MILL- WATER MANAGEMENT & EFFLUENT TREATMENT**

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

**Unit – I**

**12 Hours**

**Water management:** Global overview, global water use cycle, computing water uses, Sources of raw water, Use of fresh water in sugar industry, Water balance in sugar processing, Raw water balance in sugar mill, condenser cooling water balance, Waste water generation,

**Water conservation programme:** Resources utilization, Reduce, Reuse and Recycle: Rain water harvesting, water use from sugarcane, measures for reduction of water consumption and waste water generation from all section of sugar mill.

**Unit – II**

**12 Hours**

**Pollution sources and characteristics:** Solid waste- bagasse, filter cake, boiler ash, ETP Sludge. Liquid waste streams from – Mills, boiling house, boiler, excess condensate, cleaning, spray pond/cooling tower. Characteristics of Waste water from sugar factory

**Effluent quality: CPCB Standards for effluent disposal norms – pH, suspended solids, Oil & grease, BOD, COD & TDS.**

**Effluent treatment:** Overview of various effluent treatment systems for sugar mill effluent, Extended Aeration (EA), Activated Sludge Process (ASP), Anaerobic Lagoon (AL) +ASP, Anaerobic Digester +ASP, Bio-tower +ASP,



Moving Bed Bio-Reactor (MBBR), Membrane Bio-Reactor (MBR) , Bio-tower + Moving Bed Bio-Reactor (MBBR), Bio-tower + Membrane Bio-Reactor (MBR)

**Unit – III**

**12 Hours**

**Condensate water management:** treatment of excess condensate, need of cooling tower, cooling towers & cooling water treatment, Condensate policing units and their working

**Unit – IV**

**12 Hours**

**Operation and maintenance of ETP:** Basic ETP Operations, Maintenance of ETP equipments, Operational precautions and monitoring, Record keeping, Procedure for culture development, Maintenances of parameters- pH, MLSS, DO, Temp., Chemicals and instruments used in ETP, Wastewater sampling and analysis, Analytical methods & lab equipments for analysis of treated & untreated effluent.

**Unit – V**

**12 Hours**

Tertiary treatment for reuse of waste water- Chlorination, Ozonation, Multi-grade filter, Activated Carbon Filter, UF & RO.

## **SEMESTER V**

**Course code: 20SS506P**

**B. Sc. (Sugar Science & Technology)- Practicals –VB**

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Determination of TSS in various waters/effluents
2. Determination of TDS in various waters/effluents.
3. Determination of pH of effluents
4. Determination of total solids, suspended solids and dissolved solids of effluents, sulphate content.
5. Determination of Chemical Oxygen Demand (COD) Value of effluents by titration.
6. Determination of Dissolved Oxygen (DO) Value and Biochemical Oxygen Demand (BOD) value of effluent samples.
7. Analysis of Sugar factory effluent before & after treatment for its characteristics - TDS, pH, suspended solids, Oil & grease, BOD, COD, Ash; CPCB norms
8. Analysis of distillery effluent for its characteristics - TDS, pH, suspended solids, Oil & grease, BOD, COD, Ash; CPCB norms
9. Analysis fresh water / condensate for its characteristics – TDS, pH, suspended solids, conductivity, COD, Sugar traces, Acidity, Alkalinity, SO<sub>2</sub> content etc

### **Reference Books:**

1. Industrial Alcohol technology Handbook, NPCS board of consultant & Engineer
2. Hand book of Alcohol Technology By S. V. Patil
3. Sugar Technology for Administrators in the Indian sugar factories; ManoharRao,P.J.; JayajiraoShinde Editor Bharatiya Sugar JeevanDarshanLaxmi Rd. Pune.
4. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
5. Industrial utilization of sugar cane and its Co-products , Manoharrao, P.J., ISPCK publishers & Distributors N.Delhi

## SEMESTER V

Course code: 20SS507T

### CHEMISTRY-VB

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

### INORGANIC CHEMISTRY

#### Industrial Chemistry-I

**10 hours**

**Alloys:**Significance, types of alloys (ferrous and non ferrous alloys), preparation (fusion and electro-deposition) and their applications.

**Abrasives:**Classification, Mohr scale of hardness, Manufacture and application of carborundum, alundum, tungsten carbide.

**Glass:** physical and chemical properties of glass, raw materials, manufacture using tank furnace, Annealing of glass, types, composition and uses of glasses.

#### Industrial Chemistry-II

**10 hours**

**Cement:**Raw materials, composition of Portland cement, manufacture by rotary kiln method, mechanism of setting.

**Pigments:**Manufacture and relative merits of white lead, Lithopone, Titanium white, constituents of paints and varnishes.

**Fuels:**Characteristic and calorific values of fuels, advantages of gaseous fuels, Manufacture of water gas and biogas.

## ORGANIC CHEMISTRY

### Reagents and Reactions

10 hours

Preparation, mechanism of action and applications – DCC (Amide formation),  $\text{LiAlH}_4$  (reduction of aldehyde, carboxylic acid and ester), DDQ (Benzylic oxidation of tetralin, aromatization of tetralin), Lead Tetra Acetate (oxidation of 1,2-diols), NBS (allylic bromination),  $\text{OsO}_4$  (hydroxylation of alkenes), PCC (Pyridiniumchlorochromate) in the oxidation of primary alcohols.

### Mass Spectroscopy

04 hours

Principle, instrumentation, definitions of parent peak and base peak, McLafferty rearrangement with respect to butyraldehyde.

### Dyes

06 hours

Classification, requirement of a dye, colour and constitution.

The synthesis of each of the following class of dyes-Azo dyes-Congo red, Vat dyes-Indigo, Anthraquinone dyes-Alizarin, Triphenylemethane dyes-Malachite green, Crystal violet, Phthalein dyes-Fluorescein, Eosin.

### Physical Chemistry:

#### Surface Chemistry

10 hours

Adsorption, derivation of Freundlich and Langmuir's adsorption isotherms. Forms of Langmuir's adsorption isotherms at high and low pressure regions, BET equation (No derivation), determination of surface area using BET equation.

**Catalysis** – Theories of catalysis –intermediate and adsorption theory enzyme catalysis-Michaelis-Menten equation, industrial applications catalysis.

**Chemical equilibrium****06 hours**

Thermodynamic treatment of law of mass action, van't Hoff reaction isotherm, relationship between  $K_p$ ,  $K_c$  and  $K_x$ , variation of  $K_p$  and  $K_c$  with temperature and pressure.

**Kinetics of chain reactions****04 hours**

Examples of chain reactions, general aspects of chain reactions, chain length, chain transfer reactions, chain inhibition, kinetics branching chain reactions.

**SEMESTER V**  
**Course code: 20SS508P**  
**CHEMISTRY - Practicals –VB**

**Total Hours : 45 hours**  
**Teaching Hours / week:3 Hours**

**Credits – 1**  
**Max. Marks: 50**  
**Marks: Theory- 40+IA-10**

**Physical Chemistry Experiments:**

1. Determination of the concentration of HCl by conductometric titration using the standard NaOH.
2. Determination of the concentration of CH<sub>3</sub>COOH by conductometric titration using the standard NaOH.
3. Determination of equivalent conductance of strong electrolyte (NaCl) at infinite dilution.
4. Determination of dissociation constant of (weak acid) acetic acid conductometrically.
5. Determination of percentage composition of unknown mixture of A & B liquids using Abbe's refractometer by formula method.
6. Determination of percentage composition of unknown mixture of A & B liquids using Abbe's refractometer by graphical method.
7. Conductometric precipitation titration of NaCl vs AgNO<sub>3</sub>.
8. Determination of specific rotation of glucose solution by polarimeter.
9. Determination of solubility of sparingly soluble salt (BaSO<sub>4</sub>) conductometrically.

**Any one of the experiment may be given for the examination.**

### **REFERENCE BOOKS FOR INORGANIC CHEMISTRY**

1. Industrial chemistry : B.K.Sharma
2. Engineering Chemistry : Jain and Jain

### **BOOKS RECOMMENDED FOR ORGANIC CHEMISTRY**

1. Reaction Mechanism : P.S.Kalsi
2. Mass Spectroscopy : Y.R. Sharma
3. Synthetic Organic Chemistry : GurudeepChatwal
4. Organic Chemistry : P.L.Soni
5. Organic syntheses : Jagadmba Singh and Yadav

### **BOOKS RECOMMENDED FOR PHYSICAL CHEMISTRY**

1. Electrochemistry : Glasstone
2. Physical Chemistry : Atkins
3. Engineering Chemistry : Jain



**SEMESTER V**  
**Course code: 20SS509T**  
**B. Sc. (Sugar Science & Technology)-V C**  
**SUGAR INSTRUMENTATION**

**Total Teaching Hours : 60 hours**  
**Teaching Hours / week: 4 Hours**

**Credits – 3**  
**Max. Marks: 100**  
**Marks: Theory- 80+IA-20**

**Unit – I** **12 Hours**

**Introduction:** Introduction to Industrial Instrumentation, Recorders and Monitors, Characteristics of Instruments, static characteristics, error and types of errors, sensitivity, reproductively and dynamic characteristics.

Liquid Level measurement: Liquid level indicators. Direct Method – Hook Type, Sight glass, Float type, Indirect Method – Capacitance level indicator, Radiation level indicator.

**Unit – II** **12 Hours**

**Temperature measurements:** High temperature measurements, Mechanical, mercury in glass thermometers, bimetallic thermometers, Electrical, Thermocouples, Seebeck effect thermoelectric thermometers and pyrometers.

**Pressure and vacuum measurements:** Units and their conversions, manometers, U-type, Well type and barometer, vacuum gauges, Bourdon Tube, ionization and Pirani gauge.

**Unit – III** **12 Hours**

**Flow measurements:** Basic terms such as total flow, volumetric flow, mass flow, viscosity, Reynolds number, types of flow, flow transducers such as orifice plate, pitot tube, anu-bar, venturimeter, variable area flow meter, Rotameter, magnetic flow meter, mass flow meter.

**Unit – IV**

**12 Hours**

**Various Auto control systems in sugar industry-** Auto cane feed control system, Juice flow control system, pH control system.

**Unit – V**

**12 Hours**

**Various Auto control systems in sugar industry-** Evaporator Automation, Pan Automation, condenser automation, Boiler automation

## SEMESTER V

Course code: 20SS510P

**B. Sc. (Sugar Science & Technology)- Practicals –V C**

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. To study different types of transducer and sensors
2. To study orifice meter
3. To study temperature measurement using thermocouple
4. To study measurement of pressure
5. To study float type liquid level measurement
6. To study magnetic flow meter
7. Calibration of pressure guaze /vacuum gauzes
8. Calibration of temperature sensors
9. To prepare p/I diagram for various automation systems – mill automation, imbibition automation
10. To prepare p/I diagram for various automation systems –pH control for juice sulphitation, pan automation, sugar weighing system, condenser automation

## **REFERENCE BOOKS:**

1. R. N. Shreve : The Chemical Process Industries (MGH)
2. W. I. Badger and J. T. Bandchero: Introduction to Chemical Engineering (MGH)
3. O. A. Hougen, R. M. Watson and R. A. Ragetz: Chemical Process Principles (Vol. I. II (JW))
4. Industrial Instrumentation and Control by S. K. Singh, Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Instrumentation by : F.W. Kirk & N.R. Rimboi
6. Theory of Errors by Yardley Beers.

## **SEMESTER V**

**Course code: 20SS511T**

### **B. Sc. (SUGAR SCIENCE & TECHNOLOGY)-V D SPECIALTY SUGAR TECHNOLOGY**

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

#### **Unit – I**

**12 Hours**

Manufacturing of Khandsari Sugar: Specification of Khandsari sugar, Extraction & clarification of cane juice, Open pan boiling system, Modern pressure effect khandsaries, Application of modern methods for crystallization, Centrifuging; drying & packing

#### **Unit – II**

**12 Hours**

Manufacturing of Gur (Jaggary): Extraction of juice, Clarification of juice, Concentration of juice, Drying & grading of Gur, Storage of Gur, Composition of Gur, Factors affecting the quality of Gur, specification.

Manufacturing of Candy Sugar: Melt clarification, Crystallization technique of candy sugar, Centrifuging, drying & packing

#### **Unit – III**

**12 Hours**

Raw Sugar & VHP Sugar manufacturing- Raw Sugar, VHP, VVHP sugar specifications, massecuite boiling scheme & process overview

#### **Unit – IV**

**12 Hours**

Manufacturing of Refined Sugar: Specification of refined sugar, Types of refineries, back end and Standalone refinery, Raw sugar quality requirement, Raw Sugar Mingling & affination, Centrifugation, Clarification of raw sugar

melt by carbonation, Clarification of raw sugar melt by phosflotation, Scum desweetning alternatives, use of Ion Exchange resins for melt decolourisation, Back end refinery operation- Evaporation scheme, Sugar refining scheme, normal massecuite % cane, steam, power & water requirement

**Unit – V**

**12 Hours**

Standalone refinery operation: Evaporation scheme, Sugar refining scheme, normal massecuite % cane, steam, power & water requirement, Chemicals used for sugar refining and their quality control

**SEMESTER V**  
**Course code: 20SS512P**  
**B. Sc. (Sugar Science & Technology)- Practicals –V D**

**Total Hours : 45 hours**  
**Teaching Hours / week:3 Hours**

**Credits – 1**  
**Max. Marks: 50**  
**Marks: Theory- 40+IA-10**

1. Analysis of Jaggary for pol % & purity
2. Analysis of raw sugar for
  - Pol %,
  - Moisture %,
  - Conductivity Ash %
  - Dextran,
  - Starch,
  - RS %,
  - ICUMSA colour
3. Analysis of refined sugar for
  - colour by ICUMSA
  - Pol %,
  - Moisture %,
  - Insoluble matter,
  - Conductivity ash content
  - SO<sub>2</sub> content,
  - RS %,
  - Insoluble matter.

## **REFERENCE BOOKS:**

1. Principles of sugar technology, Honig Pieter, Elsevier publishing company Amsterdam
2. Hand book of Cane Sugar Engineering, Hugot e., Elsevier Science publishing Co.Inc. New York.
3. Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
4. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
5. Manufacture and Refining of Raw cane sugar; Baikow, V.E., Elsevier publishing Co. Am Sterdam London New-york.
6. Sugar Science and Technology, Birch, G.G. Parker, K.J. Applied science publishers Ltd. London.
7. Technology for sugar Refinery Workers, Oliver Lyle, Chapman & Hall Ltd. London
8. Handbook of Sugar Refining, Chung Chi Chou, John Wiley & Sons Inc, New York



## **SEMESTER V**

**Course code: 20SS513T**

**B. Sc. (Sugar Science & Technology)-V E**

### **CENTRIFUGATION**

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

#### **Unit – I**

**12 Hours**

**Crystallizers:** Batch type Crystallizers: crystallization in motion and at rest, Air cooling and water cooling, different types of crystallizers, Construction details of Batch type crystallisers, Vacuum Crystallisers: Concept, use, construction details.

#### **Unit – II**

**12 Hours**

**Continuous Crystallizers:** Vertical continuous crystallisers - concept, use, different types & construction details, Batch crystallisers continuous operation - concept, use, different types & construction details, Cooling and reheating of massecuite, growth of crystals, molasses exhaustion, temperature of saturation, saturoscope, massecuite reheating different methods of reheating, reheating their advantages and disadvantages.

#### **Unit – III**

**12 Hours**

**Modern batch type Centrifugal machines :** Definition of centrifugal force/centripetal force, Gravity factor, Construction and working, Monitor casing, working and backing screen, basket, plough, massecuite feeding, molasses chamber, different speeds, water wash nozzles, molasses separator, bottom hood etc

#### **Unit – IV**

**12 Hours**

**Factors affecting performance of batch type centrifugal machine:** Influence of process & operational parameters in centrifugal machine design, Purging rate, Purging efficiency, importance of washing in batch centrifugals, Dilution of massecuite and quantity of water used , Reheating of massecuite, Sequential operation of the fully automatic recycling self-discharging centrifugal machine, Modern flat bottom fully automatic centrifugal machine. Operational trouble shooting

#### **Unit – V**

**12 Hours**

**Continuous centrifugal machines:** Construction and working, Monitor casing, working and backing screen, basket, massecuite feeding, molasses chamber, water wash nozzles arrangement etc, different designs of modern continuous machines.

**Sugar handling system:** Grass hopper, Horizontal & rotary sugar dryer, Fluidized bed hoppers, Sugar elevator, Sugar Screening equipment's: Sugar Graders- Rotary type, Grass hopper type, Magnetic or vibrating type. Different grades of sugar

## **REFERENCE BOOKS:**

1. Principles of sugar technology, Honig Pieter, Elsevier publishing company Amsterdam
2. Hand book of Cane Sugar Engineering, Hugot e., Elsevier Science publishing Co.Inc. New York.
3. Training manual for sugar mills.Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
4. Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
5. Manufacture and Refining of Raw cane sugar; Baikow, V.E., Elsevier publishing Co. Am Sterdam London New-york.
6. Unit operations in cane sugar production; Payne, J.N.; Elsevier pub Co. Amsterdam.
7. Machinery and Equipment of the cane sugar factory, Tromp, L.A., Norman Rodger, 7 & 8 Idol Lane.
8. Introduction to cane Sugar Technology, Jenkins, Q.H., Elsevier scientific publishing company Amsterdam.

## **SEMESTER V**

**Course code: 20SS514 T**

**B. Sc. (SUGAR SCIENCE & TECHNOLOGY)-V F**

### **INDUSTRIAL STATISTICS**

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

#### **Objectives:**

This Course would enable the student to get acquainted with the statistical tools in order to handle massive data and arrive at conclusions. Mathematical aptitude and thinking is crucially used while dealing with quantitative problems.

#### **Unit-1**

Basic Ideas in Statistics, Function of Statistics, Methods of data collection, representation of data, Frequency distribution, Diagrammatic and graphical representations.

#### **Unit-2**

Central tendencies, Arithmetic Mean, Weighted arithmetic mean, median, mode, Geometric mean, Harmonic mean, Merits, Demerits.

#### **Unit-3**

Moment, Skewness, Kurtosis, Applications Unit-4 Simple Regression, Multiple Regression, Correlation.

#### **Unit-5**

Time Series, meaning and Utility, Components of Time Series, Additive and Multiplicative Models, Methods of estimating trends, (Linear and exponential fitting), Autoregressive Models.

**REFERENCES:**

1. Das.M.J, Statistical Methods, Das and Co Publishers Kolkata
2. Miller,J.E.Freud, Mathaemtical Statistics with applications,Pearson, New Delhi.
3. Gupta and Gupta, Business Statistics, Sultann Chad Publishers
4. Chandan.J, Statistics for Business Economics, Vikas Publish

## **SEMESTER V**

**Course code: 20SS515T**

**B. Sc. (Sugar Science & Technology)-V G**

### **DISTILLERY EFFLUENT TREATMENT TECHNOLOGY**

**Total Teaching Hours : 60 hours**

**Teaching Hours / week: 4 Hours**

**Credits – 3**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

**Unit- I**

**12 Hours**

#### **Distillery Effluent (Spentwash)-**

Definition of distillery effluent (Spentwash), Characteristics of spentwash from different process of fermentation and distillation technology, Central Pollution Control Board (CPCB) norms for disposal of distillery Effluent to achieve “Zero Spentwash Discharge”. Spentwash treatment and disposal option to achieve “Zero Spentwash Discharge”, Treatment of spentwash evaporation condensate and non-process streams, technologies available for recycle of water

**Unit- II**

**12 Hours**

#### **Distillery Effluent (Spentwash) Treatments-**

Distillery effluent characteristics for raw spentwash, biomethanated spentwash and concentrated spentwash, Overview for available and implemented spentwash treatment technologies –

- Primary effluent treatment (Biomethanation) followed by secondary effluent treatment (Spentwash evaporation/Reverse Osmosis) followed by tertiary effluent treatment (Biocomposting)
- Primary effluent treatment (Biomethanation) followed by secondary effluent treatment (Spentwash evaporation/Reverse Osmosis) followed by dryer
- Primary effluent treatment ( (Spentwash evaporation) followed by Secondary effluent treatment (Thermal/Incineration)

### **Unit- III**

**12 Hours**

**Primary effluent treatment (Biomethanation of spentwash to produce biogas)-**  
Introduction-**Biogas as an alternative energy source from distillery spentwash, Types of technologies available for biomethanation of spentwash,** Feed stock requirement for biomethanation technology, Salient features of anaerobic digestion of spentwash, Benefits and limitation of biomethanation, Steps of reactions involved during degradation of spentwash by anaerobic method, Composition of biogas and calorific values, Uses of biogas

### **Unit- IV**

**12 Hours**

**Secondary effluent treatment (Spentwash evaporation-MEE)-**

Classification of evaporators, Different types of evaporators, Effects of steam pressure & number of effects on water evaporation rate/steam economy for MEE (With TVR), Performance of evaporators

**Secondary effluent treatment (Incineration of spentwash)-**

Introduction- **Incineration, Classification and types of incinerators,** Advantage and disadvantage of incineration, Design parameters of incinerator boiler, Salient features of incinerator boiler, Analysis of fuel and final ash

### **Unit- V**

**12 Hours**

**Tertiary effluent treatment (Bio composting)-**

Introduction- **Biocompost as a fertilizer, Biocompost process,** Feed stock requirement for biocompost technology, Salient features of biocompost, Benefits and limitation of biocompost, Biocompost monitor parameters, Composition of biocompost.

## **REFERENCE BOOKS:**

1. Industrial Alcohol technology Handbook, NPCS board of consultant & Engineer
2. Hand book of Alcohol Technology By S. V. Patil
3. Sugar Technology for Administrators in the Indian sugar factories; ManoharRao,P.J.; JayajiraoShinde Editor Bharatiya Sugar JeevanDarshanLaxmi Rd. Pune.
4. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
5. Industrial utilization of sugar cane and its Co-products , Manoharrao, P.J., ISPCK publishers & Distributors N.Delhi



## SEMESTER V

Course code: 20SS516P

### B. Sc. (Sugar Science & Technology)- Practicals –V G

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Methane gas analysis
2. Analysis of compost
3. Analysis of incineration boiler ash
4. Analysis of bagasse for GCV & NCV
5. Analysis of press Mud
6. Analysis of biogas
7. Determination of total & fixed volatile acidity of spirit (ISI method).
8. Determination of Aldehyde /Ester / Fusel oil / Furfural/Methyl alcohol content of Spirit
9. Analysis of RS / Ethanol for its quality

#### REFERENCE BOOKS:

1. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
2. Hand book of Cane Sugar Technology, Mathur R.B.L., Oxford DBH publishing Co.N.Delhi.
3. Industrial utilization of sugar cane and its Co-products , Manoharrao, P.J. , ISPCK publishers & Distributors N.Delhi
4. Industrial Alcohol technology Handbook, NPCS board of consultant & Engineer
5. Hand book of Alcohol Technology By S. V. Patil

## **SEMESTER V**

**Course code: 20SS517P**

**B. Sc. (Sugar Science & Technology)-V H**

### **INDUSTRIAL VISIT (Overhauling practices) REPORT**

**Credits – 1**

**Teaching Hours / week: 3 Hours  
Marks IA - 50**

1. Preparation of station wise report for various duties performed by sugar mill during off season and list of required man power
2. Survey of various types pumps used in sugar industry with their specifications
3. Off season equipment testing procedure and standard operating procedure for various tests – Hydraulic testing , Vacuum trial, Valve hydraulic testing, No load trials of various equipment's,
4. To document procedure for various activities of electrical department in sugar mill during off season
5. Preparation of sketches of various equipment's – accessories & parts with respect to their design and industry practice

**SEMESTER V**

**Course code: 20SS518P**

**B. Sc. (Sugar Science & Technology)-V I**

**SUGAR COMPLEX ECONOMICS STUDY (SELF-LEARNING)**

**Credits – 1**

**Teaching Hours / week: 3 Hours  
Marks IA - 50**

1. Collection of Indian sweetener industry “Production& Consumption” data for last 20 years and its analysis
2. Comparison of Indian sugar industry – production / consumption / export / import trends with world sweetener industry
3. Collection and assessment of cane production / sugar production / sugar marketing/ balance sheet of any two sugar mills
4. Review of literature regarding sugar industry status and future prospects

**THE COURSE STRUCTURE AND SYLLABUS OF  
UNDER GRADUATE**

**Programme - B. Sc. (Sugar Science & Technology)  
VI - SEMESTER**

**Academic Year 2022-23**

## SEMESTER – VI

Sl. No	Course code	Name of course	Teaching hours	Duration of Exam	Marks			Credits
					IA	Exam	Total	
1	SEC	Skill Enhancement 20SS209T	2	2	10	40	50	2
2	DSC4 T	Chemistry – VI, 20SS601T	4	3	20	80	100	3
	A OR B	SST– VI, Spectrophotometry for Sugar complex 20SS603T SST–VI B, (Boiler Water Management), 20SS605T	4	3	20	80	100	3
3	DSC4 P	Chemistry Practical – VI 20SS602P	3	3	10	40	50	1
	A OR B	SST– VI A Practical Spectrophotometry 20SS604P SST– VI B, Practical – IV-B, 20SS606P	3	3	10	40	50	1
4	DSC5	SST– VI C, Research Experience at under graduation20SS607P	7		200	-	200	4
5	DSC6	SST– VI D, Industrial Training work (7 weeks). 20SS608P	45 days		400	-	400	12
<b>TOTAL</b>								<b>26</b>

Total credits in semester: 26

\*Sugar Science & Technology – SST

**Note:**

- Out of 15 weeks, Students are to be deputed to Industrial training in working sugar mills for the period of seven weeks. Holidays after 5<sup>th</sup> semester may be added in this training additionally.
- Assessment of Industrial training report is to be done by Industry experts / Sugar technology & Sugar Engineering professors.
- Teaching period in class – 6 weeks, teaching hours per week for T/P shall double. Students daily working hours in plant – 6 hours i.e. 36 hours per week. = 18 hours per week for 12 week semester
- Industrial Training period to be decided based on sugar industry crushing season working and accordingly the vacation and class work to be adjusted as per the need of student.

**SEMESTER VI**  
**Course code: 20SS609T**  
**SKILL ENHANCEMENT COURSE**  
**BREWING TECHNOLOGY**

**Total Teaching Hours : 30 hours**

**Credits – 2**

**Teaching Hours / week: 2 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

**Unit – I**

**10 Hours**

**Introduction: Beer origin, Classification and beer styles:**

The nineteenth century, Porter Vs ale, outline of the brewing steps, Malting, Milling and adjunct use, Mashing, Wort separation, Wort boiling, Trub removal, wort cooling/ aeration, Yeast handling, Yeast pitching, Fermentation, Yeast removal, Aging, Clarification, Packing and warehouse practices. Different styles of beer – Ales British Origin, Irish Origin, Germanic Origin, Belgian and French Origin, Lager beer, European and other origins.

**Unit – II**

**10 Hours**

**Basic raw materials of brewing :**

Water usage in the brewery, Brewery water, Process water, Barley and Malt : - Barley – Structure and function, the husk and the pericarp, testa, aleurone layer, starchy endosperm, the embryo.

Hops and types – chemistry, whole hops, hop resins, soft resins, hard resins, hop oils, hop resin acids, bittering value, bitter flavour and foam.

**Unit – III**

**10 Hours**

**Yeast metabolism and brewhouse technology:**

Life cycle genetics and genetics : Vegetative reproduction, Uptake and metabolism of wort nitrogen, Yeast extraction products: Alcohol, Esters, sulphur compounds,. Strain selection, storage of culture propagation,, Yeast

pitching and cell viability . Brewhouse Technology : Heat transfer, Raw materials intake, storage, removal of foreign objects, Milling and reason, roll mills.

**Mashing( Liquefication) :** Mash kettle, Lauter ton, mash filter, membrane mash filter. Wort Boiling – principles of boiling, types of boiling, Hop addition, wort clarification – separation systems, wort cooling and aeration, plate heat exchanger. Centrifugation, filtration, floatation, aeration, yeast addition.

**REFERENCE BOOKS:**

1. Fergus G. Priest and Graham G. Stewart – Second Edition.
2. Hans Michael Elinger.
3. Christ Smart – Craft Brewing – First Edition.

**SEMESTER VI**  
**Course code: 20SS601T**  
**Course: CHEMISTRY – VI**

**Total Teaching Hours : 60 hours**  
**Teaching Hours / week: 4 Hours**

**Credits – 3**  
**Max. Marks: 100**  
**Marks: Theory- 80+IA-20**

**INORGANIC CHEMISTRY**

**UNIT-I** **10 Hours**

**Coordinate compounds-II**

Crystal field theory (CFT) with reference to octahedral, distorted octahedral (Jahn-Teller) distortion), tetrahedral and square planar complexes, calculation of crystal field stabilization energy, factors affecting  $10Dq$ , consequences of crystal field splitting on ionic radii of  $M^{+2}$  ions, enthalpy of hydration of  $M^{+2}$  ions, explanation of colour and magnetic properties of magnetic complexes, limitations of crystal field theory, calculation of magnetic moment using Gouy's method.

**UNIT –II** **06 Hours**

**Metal-ligand Equilibria:**

Stability constant, stepwise and overall formation constants, trends in step wise constants, factors affecting the stability of the metal complexes with reference to the nature of metal ion and ligand.

**Chelates** – definition characteristics, factors influencing the stability of metal chelates and important of chelates.

**UNIT –III** **04 Hours**

**Organometallic chemistry:**

Introduction, classification organotransition metal complexes, 18 electron rule with respect to  $(Fe(CO)_5)$ ,  $(Ni(CO)_5)$ ,  $Mn(CO)_5^+$ , ferrocene structure and bonding in metal olefins (Zeise's Salt).



## ORGANIC CHEMISTRY

### UNIT-I 06 hours

#### Chemotherapy

Introduction, requirement of an ideal synthetic drug, classification, synthesis and uses of the following-Antipyretics-antipyrine, paracetamol, Anaesthetics-novacaine (local) and pentothal sodium (general), Antihistamines – chlorpheniramine maleate (CPM) Antimalarials-paludrine, chloroquine Antibiotics- Structure and applications of Penicillin, Tetracycline, Amoxicillin, Para pharmaceutical reagents-Benedict's reagent, sodium citrate, Barfoed reagent.

### UNIT-II 04 hours

#### Soaps and Detergents

Soaps-Introduction, manufacture by modern process, cleaning action of soap. Detergents – anionic, cationic, nonionic, with suitable examples, distinction between soaps and detergents. Emulsifiers, stabilizers and builders.

### UNIT-III 05hours

#### Reaction Mechanism

- a) Beckmann rearrangement
- b) Favorskii rearrangement
- c) Benzidine rearrangement
- d) Benzillic acid rearrangement

### UNIT-IV 05 hours

#### NMR Spectroscopy

Principle of Proton Magnetic Resonance ( $^1\text{H}$  NMR) spectroscopy, nmr spectrum, chemical shift, nuclear shielding and deshielding, spin-spin coupling (n+1) rule, intensity (height) of the signal, TMS as internal standard-advantages, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, n-propyl bromide, iso propyl bromide, ethanol, acetaldehyde and benzene.

## PHYSICAL CHEMISTRY

### UNIT-I 05 Hours

#### Physical properties and molecular structure

Introduction-dipole moment, induced dipole moment, measurement of dipole moment by temperature variation method and its applications.

### UNIT-II 05 Hours

#### Applications of emf measurements –

- 1) Determination of pH: Using hydrogen electrode, quinhydrone electrode and glass electrode.
- 2) Potentiometric titrations : Acid-base and redox titration.

### UNIT-III 05 Hours

#### Quantum chemistry

Photoelectric effect – Einstein's photoelectric equation, wave particle duality, de-Broglie hypothesis, de-Broglie equation (derivation), experimental verification – Davisson – Germer experiment.

### UNIT-IV 05 hours

#### Photochemistry

Photochemical reactions, laws of photochemistry – Beer's law, Lambert's Law, Beer-Lambert's Law, Grothus-Draper Law and Einstein's Law of photochemical equivalence, quantum efficiency or yield, reasons, for high and low quantum efficiencies with examples, fluorescence, phosphorescence, photosensitization and chemiluminescence.

## SEMESTER VI

Course code: 20SS602P

Course: CHEMISTRY PRACTICALS – VI

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

### **A. Organic estimation**

01. Estimation of phenol.
02. Estimation of aniline.
03. Estimation of acetamide.
04. Determination and saponification value of ground/coconut oil.
05. Determination of Iodine value of groundnut/coconut oil.
06. Estimation of glucose by Benedict's reagent.

### **B. Gravimetric experiments:**

01. Estimation of barium as Barium sulphate.
02. Estimation of aluminium as aluminium oxide.
03. Estimation of Iron as ferric oxide.
04. Estimation of lead as lead sulphate.

### **REFERENCE BOOKS FOR INORGANIC CHEMISTRY**

01. Advance Inorganic chemistry Vol-I and II Gurudeep Raj
02. Advance Inorganic chemistry Satya Prakash
03. Modern Inorganic chemistry R. D. Madan
04. Inorganic chemistry James Huheey
05. concise Inorganic chemistry J. D. Lee
06. Inorganic chemistry Shriver and Atkins

### **BOOKS RECOMMENDED FOR ORGANIC CHEMISTRY:**

01. Organic Chemistry P. L. Soni
02. Organic Chemistry I. L. Finar Vol-II
03. Biochemistry Voet and Voet

### **BOOKS RECOMMENDED FOR PHYSICAL CHEMISTRY:**

01. Molecular Spectroscopy C. N. Banwell
02. Physical Chemistry Atkins
03. Physical Chemistry Puri and Sharma, New edition

## SEMESTER VI

Course code: 20SS603T

B. Sc. (SUGAR SCIENCE & TECHNOLOGY)-VI A

### SPECTROPHOTOMETRY FOR SUGAR COMPLEX

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

#### UNIT 1

**12 hours**

**Spectroscopy:** General principles of absorption spectroscopy, theory of Colorimetry, Beers & Lambert Law, Instrumentation of Photoelectric Colorimeter, construction of standard curve and applications.

#### UNIT 2

**12 hours**

**UV-Visible spectroscopy:** Introduction to spectroscopy, Chromophoric Groups, factors affecting wavelength and molar extinction coefficient, application to structural problems and uses in industry instrumentation

#### UNIT 3

**12 hours**

**IR spectroscopy:** Introduction, basic principles, factors affecting IR group frequencies, Applications to structural problems and uses in industry, instrumentation

#### UNIT 4

**12 hours**

**Raman Spectroscopy:** Introduction, basic principles of Raman Spectroscopy, instrumentation applications

#### UNIT 5

**12 hours**

**Modern spectrophotometers for sugar industry–** General working of spectrophotometers, various accessories, detection techniques, Comparative study of various models spectrophotometers used in sugar industry

Use of NIR spectroscopy for sugar processing control

## SEMESTER VI

Course code: 20SS604P

### B. Sc. (SUGAR SCIENCE & TECHNOLOGY)- PRACTICALS –VIA SPECTROPHOTOMETRY FOR SUGAR COMPLEX

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Operation and process learning for different types of spectrophotometer
2. To prepare detail specifications for different spectrophotometers
3. To document working and operating principles of spectrophotometric measurements by using operation manuals from instrument manufacturer
4. Analysis of sugar cane juice for various parameters by using spectrophotometer – Phosphate content, juice colour & turbidity, starch content, Reducing sugar %
5. Analysis of sugar samples by spectrophotometer – Sugar colour & turbidity, Reducing sugar %, Dextran content, Starch content,
6. Analysis of water / waste water for different parameters by spectrophotometer
7. Analysis of Silica in boiler water with spectrophotometer
8. Calibration systems and procedures for spectrophotometers

#### REFERENCE BOOKS:

1. Instrumental Methods of Chemical Analysis by H. Kaur.
2. Instrumental methods of analysis by Strobel.
3. Instrumental methods of chemical analysis by Bhal and Tuli.

## SEMESTER VI

Course code: 20SS605T

B. Sc. (SUGAR SCIENCE & TECHNOLOGY)-VI B

### BOILER WATER MANAGEMENT

**Total Teaching Hours : 60 hours**

**Credits – 3**

**Teaching Hours / week: 4 Hours**

**Max. Marks: 100**

**Marks: Theory- 80+IA-20**

#### UNIT – I

**12 hours**

**General boiler mounting/accessories & working:** General boiler types, Water tube boiler- General parts – furnace / combustion zone / feed water tank/feed pump/ steam drum /mud drum /super heater/level indicators/economizer/air heater/ID fan/FD fan/SA fan/ etc, High pressure & low pressure boilers

#### UNIT – II

**12 hours**

**Water:** Water properties & nature, Sources of water, Use of water & basic chemistry, water related tables, Impurities in water and their effects on boiler working – scale formation – boiler tubes & economiser / carry over / Silica deposition/Super heater & turbine deposits/ Corrosion

**Water quality requirement & treatment:** General standards for boiler water/boiler feed water for high pressure as well as low pressure boilers, Objectives of boiler water treatment, External & Internal treatment

#### UNIT – III

**12 hours**

**External water treatment** - Clarification, Filtration, , Chlorination, Ion exchange, De-aeration, Reverse Osmosis, Silica removal, Oil removal, deaeration

**Ion exchange methods:** Softner, De-alkalisation, Demineralisation application & limitation, Resin

**Membrane Technology:** Ultra filtration, Nano Filtration, Reverse Osmosis, Electro-dialysis

**UNIT - IV**

**12 hours**

**Internal treatment:** Organic polymers & their role in scale inhibition, Dispersants & sludge conditioners, various chemical dosings, corrosion due to low pH, prevention of corrosion in boiler. Use of oxygen scavengers

**UNIT - V**

**12 hours**

**Boiler operations & water quality:** Boiler blow down, Reasons for boiler failures, Boiler preventive maintenance, Tubes internal chemical cleaning, water tube boilers – fire side cleaning



## SEMESTER VI

Course code: 20SS606P

### B. Sc. (SUGAR SCIENCE & TECHNOLOGY)- PRACTICALS –VIB BOILER WATER MANAGEMENT

**Total Hours : 45 hours**

**Credits – 1**

**Teaching Hours / week:3 Hours**

**Max. Marks: 50**

**Marks: Theory- 40+IA-10**

1. Analysis of boiler water& feed water for
  - pH,
  - TDS,
  - Caustic Alkalinity,
  - Total Alkalinity,
  - Oxygen,
  - Hardness,
2. Analysis of boiler water for silica content by spectrophotometer
3. Analysis of blow down water for pH , TDS, hardness
4. Analysis of boiler water chemicals for various parameters
5. Testing of boiler treatment chemicals as per the chemical manufacturers instruction manual
6. Analysis of caustic soda for quality parameters
  - Purity (as NaOH ),
  - Carbonate (as Na<sub>2</sub>CO<sub>3</sub>), max.
  - Carbonate (as Na<sub>2</sub>CO<sub>3</sub>), max.

**REFERENCE BOOKS:**

1. Practical boiler water treatment Handbook, N. Manivasakam, By Shakti Book Services, Coimbatore
2. Training manual for sugar mills. Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
3. Efficient Management of sugar factories, Mangal Singh, Somaiya publication Pvt.Ltd. Bombay
4. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.

**SEMESTER VI**

**Course code: 20SS607T**

**B. Sc. (SUGAR SCIENCE & TECHNOLOGY)-VI C**

**RESEARCH EXPERIENCE AT UNDER GRADUATION**

**Credits – 4**

**Marks: Report & Presentation- 80+IA-20**

**Max. Marks: 100**

**GUIDELINES – VARIOUS STEPS TO BE ADOPTED FOR RESEARCH**

**PROJECT WORK**

- Research topic to be selected by student in consultation with staff
- Reference work collection
- Planning of Research work
- Analytical /experimental data collection by student
- Data assessment and results interpretations
- Findings of research work
- Conclusions

## **SEMESTER VI**

**Course code: 20SS607**

**B. Sc. (SUGAR SCIENCE & TECHNOLOGY)-VI D**

### **INDUSTRIAL TRAINING WORK**

**Credits – 12**

**Marks : Report & Presentation - 400**

**Duration: 45 days**

**(Submission of report followed by presentation and viva)**

**Marks system based on each unit – each unit report – 70, each unit presentation – 30, Total – 100, Number of units – 4, Total marks - 400**

**Unit – I**

**11 days**

**Sugar cane cultivation practices – onsite training on farm**

**Unit – II**

**11 days**

**Sugar processing: one week** - Onsite training of sugar process for one week – laboratory, cane Preparation & milling, juice clarification & evaporation, Pan boiling, Cooling and condensation system, Centrifugals, Sugar handling, Sugar gradation, Sugar storage, Molasses storage, waste water treatment

**Unit – III**

**12 days**

**Sugar laboratory: One week** – various sampling and analysis technology used in sugar laboratory, Analysis of cane /juice/Bagasse/press Mud/Final molasses etc for its quality parameters and preparation of daily manufacturing report of sugar complex, Boiler feed water treatment, Boiler water treatment, waste water analysis

**Unit – IV**

**11 days**

**A - Distillery: One week-** Molasses storage, various analytical control in distillery, Operation of fermentation /distillation/ packing & storage technology, ETP treatment of distillery spent wash

**B. Boiler & power house operation** –Installed boiler specifications and its accessories / mountings, Boiler working flow diagram, Boiler water treatment plant working and operation study, Study of power production distribution system – broad specs , understanding working of power house

**Reference Books:**

- 1 Hand book of Cane Sugar Engineering, Hugot e., Elsevier Science publishing Co.Inc. New York.
- 2 Sugar Technology for Administrators in the Indian sugar factories; ManoharRao,P.J.; JayajiraoShinde Editor Bharatiya Sugar JeevanDarshanLaxmi Rd. Pune.
- 3 Training manual for sugar mills. Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
- 4 Efficient Management of sugar factories, Mangal Singh, Somaiya publication Pvt.Ltd. Bombay
- 5 Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
- 6 System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.
- 7 Industrial utilization of sugar cane and its Co-products , Manoharrao, P.J, ISPCK publishers &DistributorsN.Delhi
- 8 Industrial Alcohol technology Handbook, NPCS board of consultant & Engineer