

SHIVAJI UNIVERSITY, KOLHAPUR SUGAR TECHNOLOGY

Semester Syllabus : B.Sc. Part-II

General structure

Sugar technology syllabus is similar to general B.Sc. II syllabus. There will be two theory papers of 40 marks each for each semester. Each theory paper will have two sections. Their titles & marks distribution are as under.

Semester III

- 1) Paper V -40 Marks.
- 2) Paper VI -40 Marks.

Semester IV

- 3) Paper VII 40 Marks.
- 4) Paper VIII -40 Marks.

Practical examination will be of 100 marks. Physical, Inorganic and Organic sections carry 25, 35, 30 marks respectively. Ten marks are reserved for journal. The duration of practical examination will be of two days – six hours per day.



SUGAR TECHNOLOGY

SYLLABUS

CHEMISTRY

B. Sc. Part – II

- N.B. (i) Figures shown in bracket indicate the total lectures required for the respective unit.
 - (ii) The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective units.
 - (iii) All units should be dealt with S.I. units.
 - (iv) Industrial tour is prescribed.
 - (v) Use of recent editions of reference books is essential.
 - (vi) Use of scientific calculator is allowed.
 - (vii) Values required for spectral problems should be provided in the question paper.

Semester – III

Paper – V : Physical and Inorganic Chemistry.

Unit 1: Thermodynamics

- 1.1 : Concept of entropy: Introduction, Definition, Mathematical expression, Unit, Physical significance of entropy.
- 1.2 : Entropy changes for reversible and irreversible processes in isolated systems.
- 1.3 : Entropy changes for an ideal gas as a function of V and T and as a function of P and T
- 1.4 : Entropy change in mixing of gases.
- 1.5 : Entropy change accompanying phase transitions : (i) Solid to liquid (ii) liquid to vapor (iii) one crystalline form to another.

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- - - - - [9]

- 1.6 : Third law of thermodynamics: statement, absolute entropy, determination of absolute entropy, entropy change in chemical reactions, standard entropy.
- 1.7 : Numerical problems.

Unit 2 : Surface chemistry

----[8]

- 2.1: Introduction : Adsorption, mechanism of adsorption, factors influencing adsorption.
- 2.2 : Types of adsorption : Physical and chemical adsorption
- 2.3 : Types of adsorption isotherms
- 2.4 : Adsorption isotherms a) Freundlich adsorption isotherm (derivation expected) b) Langmuir's adsortption isotherm (derivation expected)
- 2.5 : B.E.T. isotherm, determination of surface area of adsorbents.
- 2.6 : Applications of adsorption.

Unit 3 : Physical properties and chemical constitution ----- [8]

- 3.1 : Classification of physical properties.
- 3.2 : Surface tension and chemical constitution, use of parachor in elucidating molecular structure.
- 3.3 : Viscosity, coefficient of viscosity, determination of viscosity by Ostwald's viscometer.
- 3.4 : 1.Dipole moment definition, units, polar and non polar molecules, polarization of a molecule (electronic, atomic, orientation)
 - 2. Use of dipole moment in elucidating molecular structure..
- 3.5 : Numerical problems.

Unit 4: Co-ordination Chemistry

-----[13]

- 4.1: Definition and formation of co-ordinate covalent bond in BF₃ \leftarrow NH₃ and [NH₄]⁺
- 4.2: Distinction between double salt and complex salt.
- 4.3: Werner's Theory (i) Postulates, (ii) The theory as applied to Cobalt ammines viz. CoCl₃.6NH₃, CoCl₃.5NH₃, CoCl₃.4NH₃, CoCl₃.3NH₃.
- 4.4: Description of the terms Ligand, Co-ordination number, Co-ordination sphere and Effective atomic number. Geometrical and optical isomerism in co-ordination compounds for C.N. = 4 & C.N. = 6.
- 4.5: IUPAC Nomenclature of co-ordination compounds.
- 4.6: Valence bond theory of transition metal complex w.r.t. C.N.4 and C.N.6. Limitations of valence bond theory.

Semester - III

Paper – VI : Organic and Inorganic Chemistry

Unit 1 : Spectroscopic methods

-----[13]

- 1.1 : Introduction, Nature of electromagnetic radiation, Types of electronic transitions, Advantages of spectroscopic methods over chemical methods.
- 1.2: Ultra-violet (UV) Spectroscopy : Introduction Terms used in UV spectroscopy: Chromophore, Auxochrome, Bathochromic, hypsochromic, hypochromic and hyperchromic shifts, Effect of conjugation on position of UV and visible bands. Calculation of λmax by Woodward Fischer rules for conjugated dienes and enones. Applications of UV spectroscopy : Determination of structure and stereochemistry (cis & trans). Spectral problems based on UV.
- 1.3 : Infrared spectroscopy : Introduction, principle of IR spectroscopy, fundamental modes of vibration, types of vibration, Hooke's law. Conditions for absorption of radiation and selection rule, fundamental group regions of IR spectrum, functional group region. Characteristic absorption of various functional groups. Factors affecting IR absorption band values. Applications of IR spectroscopy: Determination of structure, Identification of functional groups. Spectral problems based on IR.

Unit 2 : Stereochemistry

- - - - - [7]

- 2.1 : Introduction, Geometrical isomerism in aldoximes and ketoximes. Configuration of ketoximes–Beckmann Transformation (Mechanism and proof not expected), configuration of aldoximes.
- 2.2 : Conformational isomerism Introduction, representation of conformations of ethane by using Saw-Horse, Fischer (dotted line wedge) and Newmann's projection formulae.
- 2.3: Conformations and conformational analysis of ethane and n-butane by Newmann's projection formula with the help of energy profile diagrams. Nomenclature – D and L, R and S, E and Z systems.

Unit 3 : Alcohol Industry

- 3.1 Introduction, Manufacture of ethyl alcohol from molasses.
- 3.2 Rectified spirit, Denatured spirit, absolute alcohol and power alcohol.
- 3.3 By-products of alcohol industry.

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Unit 4 : a. Acids and Bases

- a.1 : Arrhenius concept.
- a.2 : Bronsted. Lowry concept.
- a.3 : Lewis concept.
- a.4 : Lux-Flood concept.

b. Chelation

- b.1 : A brief introduction w.r.t. ligand, chelating agent, chelation and metal chelate.
- b.2 : Structural requirements of chelate formation.
- b.3 : Difference between metal chelate and metal complex.
- b.4 : Classification of chelating agents (with specific illustrations of Bidentate chelating agents).
- b.5 : Applications of chelation w.r.t. chelating agent EDTA and DMG.

c. Non-aqueous solvents :

- - - - - [4]

- c.1 : Introduction Definition and characteristics of solvents.c.2 : Types of solvents.
- c.3 : Physical properties and Acid-base reactions in non-aqueous solvents w.r.t. liquid $\rm NH_3$ and liquid $\rm SO_2$

- - - - - [5]

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Semester - IV

Paper - VII : Physical and Inorganic Chemistry

Unit 1 : Electrochemistry

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1.1: **Collegative propreties**

Definition and examples of vapor pressure. Raoults Law, elevation of boiling point during pan boiling due to brix and Hydrostatic head diffusion, diffusion Through Cane milling process, osmosis pressure, reverse osmosis.

1.2: **Chemical Kinectics**

Order of reaction, mechanism of chemical reaction. Invrsion of sucrose, Role of inversion of sucrose in sugar industries, Muta-rotation of sugars.

1.3: Crystallsation

Laws of Crystallisation, Kinetics of Crystal growth, concentration, temperature stirring; Mechanism of growth (diffusion, viscosity, impurities); dissoulution and regrowth of crystals.

Unit 2: Applications of Electrochemistry

- 2.1 Conductometric titrations : Theory of conduc to metric titrations, general procedure, different types of conductometric titrations : (i) Strong acid against strong base. (ii) Strong acid against weak base. (iii) Weak acid against strong base. (iv) Weak acid against weak base. Advantages of conduc to metric titrations.
- 2.2 Numerical problems.

Unit 3: Catalysis :

- 3.1: Introduction.
- 3.2: Classification of catalytic reactions Homogeneous and Heterogeneous.
- 3.3: Types of catalysis.
- 3.4: Characteristics of catalytic reactions.
- 3.5: Mechanism of catalysis.
 - i) Intermediate compound formation.
 - ii) Adsorption.
- 3.6: Industrial applications of catalysts.

Unit 4: Theory of Volumetric Analysis

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----- (07)

- - - - - (05)

----- (06)

- 4.1 Acid Base titrations.
 - 4.1.1 Introduction.
 - 4.1.2 Theory of indicators w.r.t. colour change interval and Ostwald's Quinoid theory.
 - 4.1.3 Neutralization curves and choice of indicators for the following titrations
 - i) Strong acid and strong base.
 - ii) Strong acid and weak base.
 - iii) Strong base and weak acid.
- 4.2 Complexometric titration :
 - 4.2.1 General account.
 - 4.2.2 Types of EDTA titrations.
 - 4.2.3 Metalochromic indicators w.r.t. Eriochrom Black T.

Semester - IV

Paper – VIII : Organic and Inorganic Chemistry

Unit 1 A) Aromaticity :

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- 1.1.1 Introduction.
- 1.1.2 (a) Kekule structure of benzene.
 - (b) Resonance structures of benzene.
 - (c) Molecular orbital picture of benzene.
 - (d) Representation of benzene ring.
- 1.1.3 Modern theory of aromaticity -

Fundamental concepts – delocalisation of pi electrons, coplanarity and Huckel's (4n+2) rule. Applications of Huckel's rule to Naphthalene, Anthracene, Pyrrole, Furan, Thiophene and Pyridine.

- 1.1.4 Mechanism of electrophillic aromatic substitution in benzene w.r.t. Nitration, Sulphonation, Halogenation and Friedel-Crafts reaction. (Alkylation and Acylation)
- 1.1.5 Electrophilic substitution reactions of monosubstituted Benzene with special reference to nitration of Nitrobenzene and nitration of Phenol.

B)Polynuclear hydrocarbons.

- 1.2.1 Introduction.
- 1.2.2 Naphthalene Constitution and Haworth synthesis.
- 1.2.3 Physical properties.
- 1.2.4 Chemical properties : Electrophilic substitution (Nitration, sulphonation and

----[08]

halogenation) reactions, oxidation and reduction.

Unit 2 : Alcohols

- 2.1 : Alcohols : Introduction.
- 2.2: Dihydric alcohols : Nomenclature, methods of formation of (a) Ethylene glycol from ethylene, ethylene dibromide and ethylene oxide. Physical properties. Chemical reactions of ethylene glycol acidic nature, reaction with hydrogen halide, Oxidation Lead tetraacetate, HIO₄ and Nitric acid. Uses of ethylene glycol. (b) Pinacol formation, Pinacol pinacolone rearrangement and its mechanism.
- 2.3: Trihydric alcohols : Nomenclature, methods of formation of glycerol from fats and oils. Synthesis from elements carbon and hydrogen. Physical properties. Chemical reactions of glycerol reaction with electropositive metals, reaction with hydrogen halides (HCl & HI), Reaction with conc. Nitric acid in presence of conc. Sulphuric acid. Reactions with potassium hydrogen sulphate, Esterification and oxidation with Fenton's reagent. Uses of glycerol.

Unit 3: a. Synthetic Reagents

- - - - [07]

- 3.1 Ethyl aceto acetate
- 3.2 Lithium Aluminium Hydride (LiAlH4)

Preparation.

Applications w.r.t. reduction of acid, ketone, ester and anhydride.

Mechanism of reduction of carbonyl Compound.

3.3 Osmium Tetroxide (OsO4)

Preparation.

Applications w.r.t. preparation of cis 1, 2 diols and carbonyl compounds.

3.4 Dicyclohexyl carbodiimide (DCC).

Preparation.

Applications w.r.t. preparation of diacyl peroxide, aryl alkyl ether and amides.

3.5 Raney Nickel.

Preparation

Applications w.r.t. reduction of aliphatic carbon-carbon multiple bonds, reduction of Naphthalene and phenol.

Unit 4: Chemistry of Water

---- [12]

4.1 Properties of Water

4.2 The Characteristics of Bodies of Water

- 4.3 Alkalinity of water
- 4.4 Source and nature of Acidity

Cause and source of hardness

Methods for the determination of hardness

Types of hardness

- 4.5 Major aquatic chemical processes
- 4.6 Oxidation reduction reactions in water
- 4.7 pE-pH diagram
- 4.8 Complexation
- 4.9 Redox Reactions Mediated By Bacteria

Oxidation

Reduction

4.10 Nitrogen Transformation By Bacteria

Iron and manganese bacteria

Physical Chemistry Reference Books :

- 1. Physical Chemistry by G. M. Barrow (Tata Mc-Graw Hill publishing Co., Ltd.)
- 2. Elements of Physical Chemistry by S. Glasstone and D. Lewis.(D.Van Nostrand Co. Inc.)
- 3. Physical Chemistry by W. J. Moore (Orient Longman).
- 4. Principles of Physical Chemistry by S. H. Maron and C. F. Prutton. (Oxford & IBH Publishing Co.)
- 5. University General Chemistry by C. N. R. Rao (Mac-Millan).
- 6. Elements of Physical Chemistry by P. W. Atkins. (Oxford University Press).
- 7. Physical Chemistry by R. A. Alberty (Wiley Eastern Ltd.).
- 8. Physical Chemistry through problems by S. K. Dogra, D. Dogra(Wiley Eastern Ltd)
- 9. Principles of Chemistry by Puri and Sharma (S.Nagin)
- 10. Physical Chemistry by A. J. Mee. ELBS & Heinemann Educational Books Ltd.
- 11. Essentials of Physical Chemistry by B. S. Bahl and G. D. Tuli.(S.Chand)
- 12 Chemical Kinetics by K. J. Laidler (Tata Mc-Graw Hill Publishing Co. Ltd).
- 13. Text Book of Physical Chemistry by Soni-Dharmarha.
- 14. A Text Book Physical Chemistry by S. Glasstone, (Mac Millan.)
- 15. Advanced Chemistry by Philip Mathews, Cambridge University.
- 16. Instrumental methods of Chemical Analysis by Chatwal and Anand. (Himalaya Publishing House, Mumbai.)

Organic Chemistry Reference Books :

Latest editions of following reference books.

- 1. Organic Chemistry. Volume 1 The fundamental principles by I. L. Finar.
- 2. Organic Chemistry. Volume 2 Stereochemistry and the chemistry of natural. Products by I. L. Finar, Low-priced Edn. ELBS - Longman
- 3. Organic Chemistry. Volume I, II, III by S.M. Mukharjee, S. P. Singh and R. P. Kapoor. Wiley Eastern Limited.
- 4. Advanced Organic Chemistry, by B. S. Bahl, Arun Bahl. S. Chand & Company, Ltd.
- 5. Organic Chemistry by Morrison Boyd.
- 6. A Text Book of Organic Chemistry by K. S. Tiwari. S. N. Meharotra. N. K. Vishnoi. Vikas Publication, Meerut.
- 7. Spectroscopic methods in Organic Chemistry by Williams and Fleming. Mc-Graw Hill.
- 8. Stereochemistry of Organic Compounds by E. L. Eliel. Orient Longman.
- 9. Stereochemistry of Organic Compounds by P. S. Kalsi. New Age International Ltd.
- 10. Shreve's Chemical Process Industries by George T Austin. Mc Graw Hill International Edn.
- 11. Industrial Chemistry by Reigel. Asta Publishing House, Mumbai.
- 12. A Text book of Organic Chemistry by P. L. Soni. Sultan Chand & Sons.
- 13. Deductive Organic Chemistry by Kenneth Conrow, Richard N. McDonald. Indian Book Company.
- 14. Organic Chemistry by Bhupendra Mehta and Manju Mehta.
- 15. A Text book of Organic Chemistry by Lloyd N Ferguson. East West Press Pvt. Ltd.
- 16. Organic Chemistry by Louis fieser and Mery fieser. Asia Publishing House.
- 17. Principles of Organic Chemistry by James Englis and Harold Cassidy. Mc Graw Hill Book Company Inc.
- 18. A Guide Book to Mechanism in Organic Chemistry by Peter Sykes.
- 19. Advanced Organic Chemistry, structure, reactions and mechanism by Jerry March. Mc Graw Hill Kogakusha, Ltd.
- 20. Spectroscopy of Organic Compounds by P. S. Kalsi.
- 21. Absorption spectroscopy of Organic molecules by V. M. Parikh.
- 22. College Organic Chemistry Part I & II by G. R. Chatwal.
- 23. Advanced Organic Chemistry by Philip Mathews Cambridge University Press.
- 24. Stereochemistry by Nasi Puri.
- 25. Organic synthesis by Smith.

Inorganic Chemistry Reference Books :

- 1. Concise Inorganic Chemistry by J. D. Lee. ELBS 4th & 5th Edn.
- 2. Basic Inorganic Chemistry by F.A. Cotton, G. Wilkinson and P. L. Gaus Wiley.
- 3. Concepts and Models of Inorganic Chemistry by B. Douglas. D. Mc.Daniel and J. Alexander, John Wiley.
- 4. Inorganic Chemistry by A. G. Sharpe. ELBS.
- 5. Advanced Inorganic Chemistry by Satyaprakash, Tuli, Basu (S. Chand & Co.)
- 6. Inorganic Chemistry by Puri and Sharma (S. Chand & Co.)
- 7. Inorganic Chemistry by G. S. Manku. Tata Mc. Graw Hill.
- 8. Inorganic Chemistry by Agrawal.
- 9. University General Chemistry by CNR. Rao. (Mc Millan)
- 10. Industrial Chemistry by B. K. Sharma.
- 11. Environmental Chemistry by S. M. Khopkar (Wiely Eastern Ltd.)
- 12. Environmental Chemistry by A. K. De (Wiely Eastern Ltd.)
- 13. Inorganic Chemistry by D. E. Shriver. P.W. Atkins & C. H. Langford, Oxford.
- 14. Co-ordination Chemistry by R. Basolo.
- 15. Selected topics in Inorganic Chemistry: Madan, Malik, Tuli, S. Chand & Company.
- 16. Environmental chemistry by B. K. Sharma.

B.Sc. Part – II.

Laboratory Course

Note :- i) Use of Electronic / Single pan balance/Chainometric balance/Analytical Balance is allowed.

ii) Use of scientific calculator is allowed.

Physical Chemistry

[A] Instrumental

1. Viscosity :

To determine the relative viscosity of given liquids. (Density data to be given).

2. Conductometry:

- i) To determine degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically.
- ii) To determine the normality of the given strong acid by titrating it against strong alkali conductometrically.

3. Heat of ionization:

Determination of heat of ionization of weak acid by using polythene bottle.

4. Equivalent weight:

To determine the equivalent weight of Magnesium by using Eudiometer.

5. Heat of Ionisation:

Determination of heat of ionization of weak acid by using polythene bottle.

[B] Non-Instrumental

6. Chemical Kinetics:

- (i) Study of specific reaction rate of hydrolysis of methyl acetate in presence of HCl
- (ii) To study the hydrolysis of methyl acetate in presence of HCl and H₂SO₄ and to determine the relative strength of acids.
- (iii) To study the effect of acid strength (0.5 M and 0.25 M HCl) on hydrolysis of an ester.
- (iv) Study of reaction between K2S2O8 and KI (Equal concentrations).
- (v) To study the reaction between $K_2S_2O_8$ and KI (unequal concentrations)
- (vi) To study the reaction between KBrO₃ and KI. (equal concentrations)

Inorganic Chemistry

1) Gravimetric Analysis

- i) Gravimetric estimation of iron as Fe_2O_3 from a solution containing Ferrous ammonium sulphate and free sulphuric acid.
- ii) Gravimetric estimation of barium as BaSO₄ from a solution containing barium chloride and free hydrochloric acid.

2) Volumetric Analysis :

 To prepare a standard solution of Oxalic acid and determine the strength of Potassium permanganate solution in terms of normality and Kg/dm3.

ii) To prepare standard solution of Potassium dichromate and determine strength of Ferrous Ammonium Sulphate solution in terms of normality and Kg/dm3. (Use internal indicator)

iii) To prepare standard solution of EDTA and determine strength ofCaCl₂ solution using CaCO₃ salt.

3) Inorganic Preparations:

- i) Preparations of Ferrous ammonium sulphate (Mohr's salt)
- ii) Preparation of Tetrammine copper (II) sulphate.
- iii) Preparation of sodium cuprous thiosulphate.

- iv) Preparation of potassium trioxalato ferrate (III).
- v) Preparation of potassium trioxalato aluminate (III).
- vi) Preparation of tris (ethylene diamine) nickel (II) thiosulphate.
- vii) Preparation of sodium hexanitro cobaltate (III).
- viii) Preparation of ammonium diamminetetrathiocynatochromate(III) (Reineck's salt).
- ix) Preparation of chlropenta-ammine cobalt (III) chloride.
- x) Preparation of hexammine nickel (II) chloride.
- xi) Preparation of tris(thiourea) cuprous sulphate.

4) Determination of soluble Silica.

- 5) Qualitative Analysis :
 - 1) Spot Tests :

Detection of following cations using spot tests : Cu2+, Co2+, Ni2+, Fe3+,

Zn2+, Mg2+, Al3+, Pb2+, Mn2+ and Hg2+.

2) Chromatography :

Separation and identification of cations by Paper Chromatographic

technique from the following mixtures :

a) $Ni^{2+} + Cu^{2+}$

b)
$$Ni^{2+}+Co^{2-}$$

c)
$$Cu^{2+}+Co^{2+}$$

Organic Chemistry

1) Organic Qualitative Analysis

Identification of at least Ten Organic compounds with reactions including <u>two</u> from acids, two from phenols, two from bases and four from neutrals.

Acids – Benzoic acid, Cinnamic acid, Phthalic acid, Salicylic acid,

Phenols – Alpha-Naphthol, Beta Naphthol, Resorcinol

Bases - Aniline, p-Toluidine, o -,m- and p-nitroanilines,

Neutrals – Acetone, Ethyl acetate, Glucose, Chloroform, Chlorobenzene, m-Dinitrobenzene, Thiourea, Urea, Acetanilide, Carbon tetrachloride, Nitrobenzene, Naphthalene, ,

<u>Note</u> : A systematic study of an organic substance involves reactions in the determination of elements and functional group.

2) Organic Quantitative Analysis:

a.Organic Estimations

- 1) Estimation of ester.
- 2) Estimation of acetone.
- 3) Estimation of vitamin C.
- 4) Estimation of aniline.
- 5) Estimation of acetamide.

b. Organic preparations

- 1) p-nitro acetanilide from acetanilide.
- 2) Phthalimide from phthalic anhydride.
- 3) Benzoic acid from benzamide.

Physical Chemistry Reference Books:

- 1. Experimental Physical Chemistry by A. Findlay. Longman.
- 2. Advanced Practical Physical Chemistry by J.B. Yadav. (Goel Publishing house, Meerut).
- 3. Experiments in Physical Chemistry by R. C. Das and B. Behra. Tata Mc Graw Hill.
- 4. Advanced experimental Chemistry Vol. I. Physical by J. N. Gurtu and R. Kapoor. S. Chand & Co.
- 5. Experiments in Physical Chemistry by J. C. Ghosh, Bharati Bhavan.
- 6. Practical book of Physical Chemistry by Nadkarni Kothari & Lawande. Bombay Popular Prakashan.
- Systematic Experimental Physical Chemistry by S. W. Rajbhoj, Chondhekar. Anjali Publication.
- 8. Practical Physical Chemisty by B. D. Khosala & V. C. Garg. R. Chand & Sons.
- 9. Experiments in Chemistry by D. V. Jagirdar.
- 10. Practical Chemistry, Physical Inorganic Organic and Viva voce by Balwant Rai Satija. Allied Publishers Pvt. Ltd.
- 11. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
- 12. College Practical Chemistry by Patel, Jakali, Mohandas, Israney, Turakhia. Himalaya Publishing Housing, Mumbai.

Organic Chemistry Reference Books :

1. Practical Organic Chemistry by A. I. Vogel.

- 2. Hand book of Organic qualitative analysis by H. T. Clarke.
- 3. A laboratory Hand Book of Organic qualitative analysis and separation by V. S. Kulkarni. Dastane Ramchandra & Co.
- 4. Practical Organic Chemistry by F. G. Mann and B. C. Saunders. Low priced Text Book. ELBS. Longman.
- 5. Experiments in General Chemistry by C. N. R. Rao. Affiliated East-West Press Pvt. Ltd. Delhi.
- 6. Advanced Practical Organic Chemistry by N. K. Vishnoi. Vikas Publishing House Private Limited.
- 7. Comprehensive Practical Organic Chemistry Qualitative Analysis by V. K. Ahluwalia, Sunita Dhingra. University Press. Distributor – Orient Longman Ltd.
- 8. Comprehensive Practical Organic Chemistry Preparation and Quantitative Analysis by V. K. Ahluwalia, Renu Aggarwal. University Press. Distributor Orient Longman Ltd.
- Practical Chemistry Physical Inorganic Organic and Viva voce by Balwant Rai Satija. Allied Publishers Private Limited.
- 10. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
- 11. College Practical Chemistry by Patel, Jakali, Mohandas, Israney, Turakhia. Himalaya Publishing House, Mumbai.
- 12. Practice of thin layer chromatography by Joseph C. Touchstone, Murrell F. Dobbins. A Wiley – Interscience Publication John-Wiley & Sons.

Inorganic Chemistry Reference Books :

- 1. Qualitative Inorganic Chemistry by A. I. Vogel.
- 2. Quantitative Inorganic Chemistry by A. I. Vogel.
- 3. Physical Chemistry of Inorganic qualitative analysis by Kuricose & Rajaram.
- 4. Practical manual in water Analysis by Goyal & Trivedi.
- 5. Basic Concepts in Analytical Chemistry by S. M. Khopkar. Wiley Eastern Ltd.
- Practical Chemistry, Physical Inorganic Organic and Viva voce by Balwant Rai Satija. Allied Publishers Private Limited.
- 7. College Practical Chemisty by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
- 8. College Practical Chemistry by Patel, Jakali, Mohandas, Israney, Turakhia. Himalya Publishing house.
- 9. Experiments in General Chemistry by C. N. R. Rao. Affiliated East –West Press Private Ltd., Delhi.



B.Sc. Part – II Nature of Question Papers Paper V/VI/VII/VIII (Total Marks – 40)

| | Nature of Question Paper | |
|---------|--|----------|
| Q.No.1 | Multiple Choice based objective type (four options for each question be given) | 8 Marks |
| Q.No. 2 | Attempt any two of the following out of three | 16 Marks |
| Q.No. 3 | Shot notes (4 out of 6) | 16 Marks |
| | Total | 40 marks |

Note-: Other rules & regulations will be as per general B.Sc. Course



В

SHIVAJI UNIVERSITY, KOLHAPUR SUGAR TECHNOLOGY

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SUGAR TECHNOLOGY

SYLLABUS

SUGAR MANUFACTURE AND SUGAR ENGINEERING

B. Sc. Part – II

- N.B. (i) Figures shown in bracket indicate the total lectures required for the respective unit.
 - (ii) The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective units.
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Semester - III

SUGAR MANUFACTURE

Paper - V

Unit 1: Crystallization

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Theory of crystallization Crystallization zones.

Graining – Graining & Graining methods, details about graining method,

advantages and disadvantages of graining, techniques in conducting graining.

Unit 2: Vacuum pan

Construction of vacuum pan, types of pan, speed of circulation, comments, heating surface to volume ratio, pan boiling techniques, different boiling schemes.

Unit 3: Methods of preparation slurry

Procedure of making slurry, formula for size of slurry, hardening of grain, methods of preparation of slurry.

False grain & conglomerates-Formation of false grain & conglomerates, causes of formation false grain & conglomerates

Unit 4: Molasses conditioning –

- - - - - [08] Different molasses conditioning, precaution during molasses conditioning.

Crystallization in motion -Details about crystallization in motion

Solid balance -Solids balance by cobenze's diagram.

Semester – III

SUGAR ENGINEERING (Milling 1)

Paper - VI

Unit 1: Cane unloader

Cane handling -Feeding table - Power required Slope of table Chain

breaking strength ,sprocket

Main cane carrier- Objective, Length -(horizontal length .Inclined length .total length), Speed of cane carrier, Capacity of cane carrier, Slope, Width of carrier, Speed of carrier, Power required, Quantity of cane carrier, Width of carrier. Maintenance part ,Splitting of carrier, Belt type carrier.

Unit 2: Cane preparation –

Objective, Preparation index- bulk density method, sieving method,

Leaching, method, judging by eye.

Cane kicker or equiliser.

Cane knives.

Fibrizer anvil plate, hammers..

----[10]

----[07]

---- -[10]

-----[10]

Shredder.

Unit 3: Mill house construction –

Design points- material construction angle roller adjusting during setting ,simplicity of construct height of top roller Centre.

Different types of mill housing-

King bolt type housing

Bolt less type housing

Material of construction of different part of mill-

Mill head stock, Mill roller, Mill bearing, Trash plate, Scraper plate, Trash turn bean, Side caps /Top caps, Tail bar, Coupling, Crown pinion, Base frame, Shaft of pinion, Gear wheel/master gear, Top roller flange, Juice rings, Foundation, Donnelly chill, Mill tray

Unit 4: Mill force diagram -

Axial plane, Apex angle, Neutral plan, Resultant force, Horizontal reactor, Total hydraulic load on mill ,Mill angle.



Semester – IV

SUGAR MANUFACTURE

Paper – VII

Unit 1: a) Centrifugal- Construction & working.

- - - - - - - [08]

····· [10]

---- [10]

b) Factors influences on time of curing.

c) spontaneous combustion.

Unit 2: a) Centrifugal force

- - - - - - - [10]

b) Mean equivalent radius

c) Gravity factor

d) Meaning and fundamental calculation regarding centrifugal.

Fully automatic recycling self discharging centrifugal machine 3 speed cycle, 4 speed cycle , Advantages and disadvantages of batch / continuous centrifugal machine.

•

a) Various parts regarding drying and cooling, rotary dryer, multitray gross hopper, fluidized bed hopper.

b) Sugar Grader – Types of grader, dilution indicator,keeping quality factor safty factor.

c) Sugar Dust collection system –Advantages and significance of dust collector ,mechanism types.

d) Sugar Godown – Location, stalking of sugar bags.

Semester – IV SUGAR ENGINEERING (Milling 2)

Paper - VIII

----[08]

a) Mill Roller- (Type, design)

Key points of roller maintenance, Basic concept of pressure feeder.

b) Imbibition-Importance, effect, types, method, Object of

imbibitions, Imbibition efficiency

Unit 1:

| Unit 2: | Milling grooves – | [09] |
|---------|--|--------------|
| | a) Messchart grooves, Chevron groove, important point | ts regarding |
| | roller groove. | |
| | b) Mill bearing – design ascepts, lubrication types, coo | oling water. |
| | Types of bearing. | |
| | c) Central lubricating system | |
| | | |
| Unit 3: | a) Hydraulic system- types – | [10] |
| | b) Distribution of presser on roller- | |
| | c) Fibre loading, Fibre index | |
| | | |
| Unit 4: | a) Mill speed | [10] |
| | b) Power requirement for mill | |
| | c) Capacity of mill | |
| | d) Mill setting | |
| | | |

REFERENCE BOOKS:-

i)Hand book of cane sugar –Meade &Chen

ii)Introduction to cane Sugar technology- Jenkins G.H

iii)Unit operation in cane sugar production –John H. Payne

iv)Manufacture of sugar from sugarcane –C. G. M. perk

v)Efficient Management for sugar factories –Mangal Singh

vi)Cane sugar Manufacture in India- D.P. Kulkarni .

PRACTICALS:-

i) TO determine the size of crystal in seed/slurry/Massecuite

ii) To determine the pty. of the given sample of Gur.

iii) To determine the Reducing Sugar in the given sample of Gur.

iv) To determine the Net Rendement of the given sample of Gur.

v) Analysis of Sulphur

vi) Analysis of Lime.

Ι

- vii) Analysis of sugar (Pol %, Moist%, M.S., %, Ash%, ICUMSA)
- viii) Analysis of Molasses (Bx/Pty,R.S>T>R>S.,Cound.Ash%)
- ix) To determine Crystal %Massecute by
 - x) Non Sugar Method, ii) Purity Method, iii) Ash Method
- xi) Lab. Centrifuge Method
- xii) To determine viscosity of given sample by digital viscometer
- xiii) To determine shock liming dose cl.of juice
- xiv) Analysis of Brix %, purity, Ash%, Raw Sugar.
- xv) Calculate Icumsa by colorimeter.



Shivaji University, Kolhapur

B.Sc. Part – II

Nature of Question Papers Paper V/VI/VII/VIII

(Total Marks – 40)

| | Nature of Question Paper | |
|---------|--|----------|
| Q.No.1 | Multiple Choice based objective type (four options for each question be given) | 8 Marks |
| Q.No. 2 | Attempt any two of the following out of three | 16 Marks |
| Q.No. 3 | Shot notes (4 out of 6) | 16 Marks |
| | Total | 40 marks |

Note-: Other rules & regulations will be as per general B.Sc. Course



В

SHIVAJI UNIVERSITY, KOLHAPUR SUGAR TECHNOLOGY

Semester Syllabus : B.Sc. Part-II

General structure

Sugar technology syllabus is similar to general B.Sc. II syllabus. There will be two theory papers of 40 marks each for each semester. Each theory paper will have two sections. Their titles & marks distribution are as under.

Semester III

- 1) Paper V -40 Marks.
- 2) Paper VI -40 Marks.

Semester IV

- 3) Paper VII -40 Marks.
- 4) Paper VIII 40 Marks.

Practical examination will be of 100 marks and will be taken at the end of the year. Ten marks are reserved for journal. The duration of practical examination will be of two days – six hours per day.



SUGAR TECHNOLOGY

SYLLABUS

CHEMICAL ENGINEERING AND CHEMICAL CONTROL

B. Sc. Part – II

N.B. (i) Figures shown in bracket indicate the total lectures required for the respective unit.

- (ii) The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective units.
- (iii) All units should be dealt with S.I. units.
- (iv) Industrial tour is prescribed.
- (v) Use of recent editions of reference books is essential.
- (vi) Use of scientific calculator is allowed.
- (vii) Values required for spectral problems should be provided in the question paper.

Semester – III

CHEMICAL ENGINEERING Paper - V

-----[09]

Unit 1:

Introduction study of elementary chemical engineering: concepts. classification of chemical processes. material balance with and without chemical reaction. process calculations involving various unit operations.

Unit 2:

----- [09]

Fluid flow fundamentals laminar and turbulent flow. Bernoullis theorem and its application, friction factor pump selection and applications.

Unit 3:

-----[10]

Heat transfer fundamentals types of heat exchangers. Design of heat exchange equipments and their applications to distillery industry.

Unit 4:

Mechanism of heat transfer by conduction, convection and radiation.

Heat loss by conduction through series of solids under steady state condition. Overall heat transfer coefficient. Heat transfer by convection. Heat transfer equipment ,types of heat exchangers. Design of heat exchange equipment ,fouling factors. Condensation of vapours, effect of non-condensable gases.

REFERENCE BOOKS:

- I) Stoichiometry –Bhatt and vora
- II) Introduction to chemical Engineering- Badger and Baneo
- III) Introduction to- Ghosal & Sanyal chemical Engineering

Semester – III

CHEMICAL CONTROL (Mill House)

Paper - VI

Unit 1:

.....[09]

i) Technical Definition

ii) Fundamental Formulae

- - - - - [10]

- iii) Calculation Of Bx % Bagasse, Fiber % Bagasse
- iv) Added Water % Fiber
- v) Added Water Extracted % Added Water

Unit 2:

·····[10]

i)Methods of Control – Differential and Inferential

ii)Primary Extraction – Juice, Pol

iii)Secondary Extraction using simple and compound imbibitions, ideal extraction

iv)Mill extraction

v)Reduction Mill Extraction by Noel Deer, B.L. Mittal

Unit 3:

·····[10]

----- [08]

Inferential methods for calculations of :

- Bagasse % Cane
- Mixed Juice % Cane

Brix % Cane

Undil Juice % Cane

Added Water % Cane

Calculation of comparison of cane

Unit 4:

Methods of weight of mill efficiency

Reference Book:

- i) Cane Sugar Hand Book Meade & Chen
- ii) Systems of technical control for sugar factories in India N. C. Verma
- iii) Cane sugar Hand Book RBL Mathur
- iv) Training Manual For Sugar Mills Mangalsingh



Semester – IV

CHEMICAL ENGINEERING

Paper - VII

Unit 1:

-----[10]

Introduction :Study of elementary chemical engineering concepts. Batch and continuous, steady and unsteady processes. Material balance without chemical reaction. Combustion calculation, combustion of solid ,liquid and gaseous fuels. Energy balance and application to sugar industry. Industrial process calculations involving various unit operations.

Unit 2:

-----[08]

Fluid Flow: fundamentals. Reynolds's number, friction factor, Equation of continuity. Energy balance equation for fluid flow, pipes and fittings, flow measurement, different types of pumps and their working principles. Pump selection and applications.

Unit 3:

----[10]

·····[10]

Evaporation, factors affecting heat transfer. Single and multiple effect

Evaporators and factors affecting their performance. optimum number of effects. different types of evaporators and their industrial applications. Evaporator accessories. steam economy measures.

Unit 4:

Mechanical separation processes and their industrial application :

Sedimentation, laws of setting, stokes equation, batch settling tests design features of continuous thickeners determination of thickener area factors affecting setting rate. Different types of setting equipments, application of industry. Cyclone separators theory and application.

a) Filtration-theory, constant pressure and constant –rate filtration .filtration equipments and their process applications. Rotary vacuum filters. Filtration troubles causes and remedies. Filter aids and uses.

b) Centrifugation-theory different type of centrifugal machines, batch and continuous type, and their performance study.

c) Psychrometry-definition, humidity chart, wet bulb and dry bulb and dry bulb, temperature, humidification, cooling towers and spray ponds.

Semester – IV CHEMICAL CONTROL (Mill House) Paper - VIII

Unit 1:

Mill House Control:

Definition, Basic formule for cane, Added water etc., Methods of control – Differential and Inferential mill ern. Primary extrn., Secondary extrn., R.M.E. Methods of comparison of milling efficiency "Java" methods of control, E.R.Q.V. brix curves, Ideal extraction evaluation.

Unit 2:

Boiling House Control:

SJM Formula derivation, Winter Carp's Formulae-Inter relationship of above with each other – stock taking –boiling house losses and boiling house efficiency – virtual pty. Of final molasses. R.B.H.R. by Deer and G'Rao clarification Efficiency and clarification factor, Actual F.Mol. & Thereotical. Brix balance, Pol balance, N.S. balance, Thereotical. Brix balance, Pol balance, N.S. balance, Crystal balance and their interpretation capacity utilization – Time Account – crushing rate per 24 Hrs. and per 22 Hrs.

Unit 3:

i) Brix Curve

ii) Brix free cane water

iii) Undil juice lost % fiber

iv) ERQV

- - - - - - [10]

·····[10]

-----[09]

v) Java Ratio

Unit 4:

----[08]

Operation excluding and including stoppages E.S.E. and Recovery (E.S.G.), conversion of Raw Sugar Recovery into White Sugar Recovery. Known and Unknown losses, Reduced overall recovery/extraction.

Reference Book:

- i) System of Tech. control for cane sugar factories in India (Revised) by N. C. Verma.
- ii) Standard Fabrication practices for cane sugar mills (Elsevier Publication.
- iii) Manufacture of sugar from sugar cane by C.G.M. Perk.
- iv) Training Manual for sugar Mills Mangal Singh.

PRACTICAL

CHEMICAL CONTROL

1-DETERMATION OF MJ% CANE IN GIVEN SAMPLE
2-DETERMATION OF ADDED WATER PERSENT CANE IN GIVEN SAMPLE
3-DETERMATION OF BAG PERSENT CANE OF GIVEN SAMPLE
4-DETERMATION OF POL MJ% CANE OF GIVEN SAMPLE
5-DETERMATION OF POL IN BAG PERSON CANE OF GIVEN SAMPLE
6-DETERMATION OF POL IN CANE GIVEN SAMPLE
7-DETERMATION OF MILL EXTRACT OF GIVEN SAMPLE
8-DETERMATION OF REDUCED MILL EXTRACT BY NOEL DEER
9-DETERMATION OF FIBER %BAG OF GIVEN SAMPLE
10-DETERMATION OF FIBER %CANE OF GIVEN SAMPLE
11-DETERMATION OF FIBER %CANE OF GIVEN SAMPLE
12-DETERMATION OF ADDED WATER %FIBER



B.Sc. Part – II Nature of Question Papers Paper V/VI/VII/VIII (Total Marks – 40)

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