



# Shri Vaishnav Vidyapeeth Vishwavidyalaya

## B.Sc. (Chemistry Hons)

Choice Based Credit System (CBCS) (Batch 2017-2020)

| COURSE CODE | CATEGORY | COURSE NAME                            | L | T | P | CREDITS | TEACHING & EVALUATION SCHEME |               |                      |                         |                      |
|-------------|----------|--|---|---|---|---------|------------------------------|---------------|----------------------|-------------------------|----------------------|
|             |          |  |   |   |   |         | THEORY                       |               | PRACTICAL            |                         |                      |
|             |          |  |   |   |   |         | END SEM University Exam      | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| BSHCH 602   | DC       | Unit Operations in Chemical Industries | 4 | 0 | 0 | 4       | 60                           | 20            | 20                   | 0                       | 0                    |

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

**\*Teacher Assessment shall be based following components: Quiz/Assignment/Project/Participation in Class, given that no component shall exceed more than 10 marks.**

### Course Objectives:-

The course will cover the operations in chemical industries with special emphasis on alkylation, nitration, halogenation, sulphonation, oxidation and reduction.

1. To give knowledge of Unit Processes in Organic Chemicals Manufacture.
2. To develop the understanding of various organic synthesized process.

### Course Outcomes:-

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes. The student will demonstrate capability of the following,

- CO1. Theoretical understanding of Organic Chemicals Manufacture  
CO2. Became aware of various organic synthesized process

### UNIT-I Alkylation and Halogenation:

Alkylation: Introduction, types of alkylation, alkylating agents, mechanism of alkylation reactions, manufacturing process of phenyl ethyl alcohol. Halogenation: Introduction, reagents for halogenations, halogenations of aromatics – side chain and nuclear halogenations, commercial manufacture of chlorobenzene, chloral.

## **UNIT-II Nitration and Sulphonation:**

Nitration: Introduction, nitrating agents, mechanism and nitration of paraffin hydrocarbons - benzene to nitrobenzene, m-dinitrobenzene, chlorobenzene to o & p-nitrochlorobenzenes. Sulphonation: Introduction, sulphonating agents, chemical and physical factors in sulphonation, mechanism of sulphonation, commercial sulphonation of benzene, naphthalene.

## **UNIT-III Oxidation and Hydrogenation:**

Oxidation: Introduction, types of oxidation reactions, oxidizing agents, mechanism of oxidation, liquid phase oxidation and vapour phase oxidation, commercial manufacture of benzoic acid, acetic acid. Hydrogenation: Introduction, catalysts for hydrogenation reactions, hydrogenation of vegetable oil, manufacture of methanol from carbon monoxide and hydrogen, catalytic reforming.

## **UNIT-IV Esterification and Hydrolysis:**

Esterification: Introduction, esterification by organic acids, by addition of unsaturated compounds, esterification of carboxy acid derivatives, commercial manufacture of ethyl acetate. Hydrolysis: Introduction, hydrolyzing agents, mechanism of hydrolysis.

## **UNIT-V Amination:**

Introduction, methods of reduction by metal and acid, catalytic sulfide, electrolytic, metal and alkali sulfites, metal hydrides, sodium metal. Commercial manufacturing process of m-nitroaniline, p-aminophenol. Aminolysis: Introduction, aminating agents, factors affecting.

## **REFERENCES**

1. P. H. Groggins: Unit Processes in Organic Synthesis (MGH)
2. F. A. Henglein: Chemical Technology (Pergamon)
3. M. G. Rao and M. Sittings: Outlines of Chemical Technology (EWP)
4. Clausen, Mattson: Principles of Industrial Chemistry
5. H A. Lowenheim and M. K. Moran: Industrial Chemicals
6. Kirk and Othmer: Encyclopedia of Chemical technology
7. Kent, Riegel's Industrial Chemistry (N-R)
8. S. D. Shukla and G. N. Pandey: A Textbook of Chemical Technology, Vol-II
9. J. K Stille: Industrial Organic Chemistry (P.I I.)



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|             |          |                                    |   |   |   |         | THEORY                       |               | PRACTICAL            |                         |                      |
|             |          |                                    |   |   |   |         | END SEM University Exam      | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| BSHCH 603   | DC       | Quantum Chemistry & Photochemistry | 4 | 0 | 0 | 4       | 60                           | 20            | 20                   | 0                       | 0                    |

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

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### Course Objectives:-

- 1.To give basic knowledge of concept of quantum Chemistry and Photochemistry.
- 2.To develop the understanding of Quantum Chemistry and Photochemistry.

### Course Outcomes:-

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes. The student will demonstrate capability of following

- CO1. Theoretical understanding of concept concept of quantum mechanics  
CO2. Became aware of Quantum Chemistry and Photochemistry.

### Unit I: Quantum Chemistry

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and “particle-in-a-ox” (rigorous treatment).

### Unit II: Quantum Chemistry

Quantization of energy levels, zero-point energy and Heisenberg Uncertainty

principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

### **Unit III: Quantum Chemistry**

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy. Rigid rotator model of rotation of diatomic molecule.

### **Unit IV: Photochemistry**

Laws of photochemistry: Grotthus-Draper law, Stark-Einstein law of photochemical equivalence and Lambert-Beer's law; quantum yield and its measurement for a photochemical process.

### **Unit V: Photochemistry**

Actinometry. Photostationary state. Photosensitized reactions. Kinetics of HI decomposition,  $H_2$ - $Br_2$  reaction, dimerisation of anthracene.

## **REFERENCES**

1. F. L. Pilar: Elementary Quantum Chemistry, Dover Publications, Inc. NY, 1990. 2nd Ed.
2. P. W. Atkins and R. S. Friedman: Molecular Quantum Mechanics, 3rd Ed., Oxford Univ. Press, 1997
3. Ira N. Levine: Quantum Chemistry, Prentice Hall
4. A. K. Chandra: Introduction to Quantum Chemistry, Tata McGraw Hill
5. Fleming: Pericyclic Reactions, Oxford University Press, Oxford, 1999.
7. S.M. Mukherjee, S.P. Singh: Pericyclic Reactions, MacMillan India, New Delhi.
8. Sankararaman, S: Pericyclic Reactions -Applications and Theory, Wiley –VCH, 2005.



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|               |          |   |   |   |   |         | THEORY                       |               | PRACTICAL            |                         |                      |
|               |          |   |   |   |   |         | END SEM University Exam      | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| BSHCH 604 (I) | DE       | Effluent treatment and waste management | 4 | 0 | 0 | 4       | 60                           | 20            | 20                   | 0                       | 0                    |

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### Course Objectives:-

1. To impart knowledge on sources and characteristics of various industrial wastes and strategies for its prevention and control.
2. To develop the understanding of management process of industrial wastes.

### Course Outcomes:-

The students completing the course will have an insight into the pollution from major industries including the sources and characteristics of pollutants

CO1 Ability to plan minimization of industrial wastes

CO2 Ability to design facilities for the processing and reclamation of industrial waste water.

### UNIT I: Introduction

Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health Environmental

legislations related to prevention and control of industrial effluents and hazardous wastes

### **UNIT II: Cleaner production**

Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.

### **UNIT III: Pollution from major industries**

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer.

### **UNIT IV: Treatment technologies**

Equalisation – Neutralisation – Removal of suspended and dissolved organic solids – Chemical oxidation – Adsorption – Removal of dissolved inorganics – Combined treatment of industrial and municipal wastes – Residue management – Dewatering – Disposal

### **UNIT V: Hazardous waste management**

Hazardous wastes – Physico chemical treatment – solidification – incineration – Secure landfills. Biomedical waste and its treatment methods.

## **REFERENCES**

1. Rao M. N. & Dutta A. K: Wastewater Treatment, Oxford – IBH Publication, 1995
2. Eckenfelder W.W. Jr: Industrial Water Pollution Control, McGraw Hill Book Company, New Delhi, 2000
3. Patwardhan. A.D: Industrial Wastewater Treatment, Prentice Hall of India, New Delhi 2010
4. Stephenson R.L. and Blackburn J.B: Industrial Wastewater Systems Hand book, Lewis Publisher, New York, 1998
5. Freeman H.M: Industrial Pollution Prevention Hand Book, McGraw Hill Inc., New Delhi, 1995
6. Bishop, P.L: Pollution Prevention: Fundamental & Practice, McGraw Hill, 2000
7. Pandey: Environmental Management, Vikas Publications, 2010



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|                |          |                                   |   |   |   |         | THEORY                       |               | PRACTICAL            |                         |                      |
|                |          |                                   |   |   |   |         | END SEM University Exam      | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| BSHCH 604 (II) | DE       | Chemistry of Cosmetics & Perfumes | 4 | 0 | 0 | 4       | 60                           | 20            | 20                   | 0                       | 0                    |

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**\*Teacher Assessment shall be based following components: Quiz/Assignment/**

**Project/Participation in Class, given that no component shall exceed more than 10 marks.**

### Course Objectives:-

Provide knowledge on cosmetics, related sciences and cosmeceuticals (cosmetics with skin, hair and oral care benefits) and personal care and hygiene products.

Provide multidisciplinary scientific knowledge to gain expertise in the field and to respond the industry challenges effectively.

### Course Outcomes:-

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes. The student will demonstrate capability of following,

CO1. Provide with knowledge on marketing approaches on studying consumer need managing competition and global markets

CO2. Became aware of quality assurance in cosmetic and perfume industry

### Unit-I: Cosmetic chemistry I

The significance of amino acids, proteins, lipids, waxes and fatty acids in cosmetic industries. Chemistry in brief of silicones, clay minerals natural and synthetic silicates, their properties and uses in preparation of cosmetics. Viscosity Modifiers –eg, gum, alcohol and electrolytes, solvents etc. Insoluble Metallic soaps: Methods

of manufacture and uses. Pearls and Pearl Essence: Definitions, commercial uses, production methods, synthetic pearly substances. Synthetic Surfactants: Classification, commercial, commercial surfactants, cosmetic uses. Humectants and Polyols: choice and uses in preparation of cosmetics.

## **Unit-II: Cosmetic chemistry II**

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams) and antiperspirants. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

## **Unit-III: Source of raw material and their uses in formulation**

Essential oils –Production equipment, water distillation, Steam distillation. Flower oils –Extraction with cold fat and hot fat, alcoholic extracts, absolute of enflurages and chassis. Extraction with volatile solvents, selection of solvent and extraction apparatus. Resins, Gum and Exedution: extraction processes by Soxhlet Apparatus, percolation and maceration technique. Oleo Resins –Ginger oleoresins. Isolates – Methods of Isolation, properties & uses of following: Eugenol, Pinene, Linalool, Citral and Geraniol.

## **Unit-IV: Fixatives –Sources, Classification, Chemical composition and uses**

Animal Source –Civet, Musk, Ambergris. Resinous Fixatives –Benzoins, Balsam, Myrrh. Essential oil Fixatives –Sandalwood, Lemon, Cinnamon. Synthetic Fixatives. Diethyl Pthalate, Benzyl Benzoate, alcohols. Synthesis of following odorous materials - Vanillin, Heleotropins

## **Unit-V: Quality Assurance Techniques in cosmetic and perfume industry**

Importance of quality control in cosmetic preparation and guidelines for hygienic manufacture of cosmetics and perfumes. Stability testing of various cosmetics products –accelerated stability study. Study of Rheological properties of semisolid preparation.-ICH guidelines. ISO: Its significance, role and importance in cosmetic and perfume industry. Testing of packaging components used for cosmetic products. Field trip to nearby cosmetic and perfume industry to know how the quality assurance protocol.



## REFERENCES

1. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
2. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut
3. Edward Sagarin: Cosmetics: Science and Technology, Interscience Publishers, Inc., New York, 1957.
4. W. A. Poucher: Perfumes, Cosmetics & Soaps, Vol. I,II,III, Ed.: Chapman & Hall.
5. Perfumes, Flavours and Essential oil Industries –SBP Board.
6. Giriraj Prasad: Manufacture of Perfumes, Cosmetics & Detergents, 8<sup>th</sup> edition, Small industry research institute
7. D.D.Wasule: Perfumes: History & Chemistry Vol-I
8. Sagarin: Cosmetics: Science & Technology
9. Gunther: Essential oils Vol. I
10. Poucher: Perfumes, soaps & Cosmetics



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|                 |          |                                     |   |   |   |         | THEORY                       |               | PRACTICAL            |                         |                      |
|                 |          |                                     |   |   |   |         | END SEM University Exam      | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| BSHCH 604 (III) | DE       | Current Trends in Organic Synthesis | 4 | 0 | 0 | 4       | 60                           | 20            | 20                   | 0                       | 0                    |

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### Course Objectives:-

1. To give knowledge of Current Trends in Organic Synthesis
2. To develop the understanding of various organic synthesized process

### Course Outcomes:-

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

CO1. Theoretical understanding of current trends in Organic synthesis

CO2. Became aware of various organic synthesized processes.

### Unit-I Addition to carbon-carbon multiple bond:

Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, Orientation and stereochemistry.

### Unit-II Addition to carbon-hetero atom multiple bond:

Addition to cyclopropanes, Hydrogenation of double bond and triple bonds.

Hydrogenation of aromatic rings, hydroboration, Michael reaction, Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters, and nitriles, Addition of Grignard reagents, organozinc and organolithium reagents to carbonyls and unsaturated carbonyl compounds,

### **Unit-III Mechanism of molecular rearrangement-I:**

Classification and General mechanistic treatment of electrophilic, nucleophilic and free radical molecular rearrangement. Mechanism of the following rearrangement –Wagner-Meerwin, Pinacol-Pinacolone, benzil-benzilic acid, Favorski, Wolff, Arndt-Eistert synthesis, Curtius Lossen, Beckman, Hoffman, Schmidt rearrangement. Elimination reactions:.

### **Unit IV: Mechanism of molecular rearrangement-II:**

The E1, E2 and E1cB mechanisms and orientation of the double bond, Saytzeff and Hoffman's rule, Effect of substrate structure, attacking base, leaving group and medium, Mechanism and orientation in pyrolytic elimination Free radical reactions: Generation of free radicals, Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, aliphatic substrate,

### **Unit V: Synthesis involving basic principles of green chemistry:**

Neighbouring group assistance, reactivity for aliphatic and aromatic substrates, reactivity in attacking radicals, effect of solvent on reactivity. Halogenation at an alkyl carbon, allylic carbon (NBS), hydroxylation at an aromatic carbon by means of Fenton's reagent. Auto-oxidation, chlorosulphonation (Reed Reaction) Coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction.

## **REFERENCES**

1. R.K. Bansal: A Textbook of organic chemistry
2. V.K. Ahluwalia and M. Kidwai: New trends in green chemistry, Anamaya publishers New Delhi
3. John Joule: Heterocyclic Chemistry, Oxford University Press
4. Cary and Sundberg: Advanced organic Chemistry, part A and part B, Springer