**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

# B. Tech.-I (Ind. Chem.) (Sem. – I)

| Sr. No. | Subject | Code | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---|---|---|---|---|---|
| | **First Semester (1st year of B. Tech. Ind. Chem.)** | | | | |
| 1 | Introduction to Physical Chemistry | IC101 | 3-0-2 | 4 | 85 |
| 2 | Fundamentals of Inorganic Chemistry | IC103 | 3-0-2 | 4 | 85 |
| 3 | Environmental Pollution And Waste Management | IC105 | 3-0-0 | 3 | 55 |
| 4 | Mathematics for Chemistry | MA121 | 3-1-0 | 4 | 70 |
| 5 | Indian Value System and Social Consciousness | HS120 | 2-0-0 | 2 | 40 |
| 6 | Engineering Drawing | ME110 | 2-0-4 | 4 | 100 |
| | | | **Total** | **21** | **435** |
| 7 | Vocational Training / Professional Experience (Optional) (Mandatory for Exit) | CYV01 / CYP01 | 0-0-10 | 5 | 200 (20 x 10) |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – I (Ind. Chem.), Semester – I<br>INTRODUCTION TO PHYSICAL CHEMISTRY<br>IC101 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Learn the concept of solubility, solubility product and ionic solutions. |
| CO2 | Acquire knowledge on adsorption and their isotherms. |
| CO3 | Classify colloids, types, their properties and applications. |
| CO4 | Understand the equilibrium process involved in chemical processes. |
| CO5 | Demonstrate the phase diagrams and equilibria. |

| 2. | Syllabus | |
|---|---|---|
| | **IONIC EQUILIBRIA** | **(06 Hours)** |
| | pH scale, common-ion effect, buffer solutions, Henderson-Hasselbalch equation, salt hydrolysis, acid-base indicators, acid-base titrations, solubility product, applications of solubility products, Numericals. | |
| | **ADSORPTION** | **(08 Hours)** |
| | Adsorption, classification of adsorption, factors influencing adsorption, adsorption of gases on solids, adsorption from solutions, applications of adsorption. Adsorption isotherms: The Freundlich adsorption isotherm, the Langmuir theory of adsorption, the BET theory of multilayer adsorption, the Gibbs adsorption isotherm. | |
| | **COLLOIDS** | **(08 Hours)** |
| | Definition, general properties of colloids (optical, kinetics and electrical), Types of colloidal system (Foam, aerosol, emulsion, smoke), Classifications of colloids (lyophilic and lyophobic), preparation and purification of colloids, coagulation of Sols, origin of charge on Colloids, Stability of Colloids, protective Colloids, Associated colloids (Micelles, CMC, Krafft temperature, and applications), Applications of colloids. Emulsions & Gels: Types, properties, and applications. | |
| | **CHEMICAL EQUILIBRIA** | **(08 Hours)** |
| | Introduction, equilibrium constants ($K_c$, $K_p$ and $K_x$), Temperature- and pressure-dependence of equilibrium constants, vant Hoff equation, heterogeneous equilibria, chemical potential, Gibbs-Duhem equation, Gibbs-Duhem-Margules equation, Free energy change of mixing and entropy change of mixing, Numericals. | |
| | **DISTRIBUTION LAW** | **(07 Hours)** |
| | Statement and explanation, limitations, effect of molecular state, determination of equilibrium constants, determination of coordination number, solvent extraction- single and multiple extractions, applications of distribution law. | |
| | **PHASE RULE** | **(08 Hours)** |

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| | |
|---|---|
| | Definition of Phase, Phase boundaries, Components, degree of freedom, phase rule, Thermodynamic condition for phase equilibrium, Phase rule and its derivation, Phase equilibrium for one component system (for eg: $H_2O$, S, $CO_2$), First and second order phase transition, Clapeyron equation, Clausius-Clapeyron equation, Liquid vapor equilibrium for two component system, Critical solution temperature, completely immiscible systems, Simple eutectic systems: Zn-Cd, Pb-Ag. |
| | **Practical will be based on the coverage of the above topics separately (30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** |

| **3.** | **Practical will be based on** |
|---|---|
| 1 | Preparation of Solution, Calibration and Standard Deviation. |
| 2 | Determination of the partition coefficient of $I_2$ between $CCl_4$ and water. |
| 3 | Study of adsorption of acetic acid on charcoal. |
| 4 | Determination of the rate constant of decomposition of $H_2O_2$ by acidified KI solution. |
| 5 | Preparation of the colloidal solution of (i) Gelatin (ii) Sulphur (iii) Ferric hydroxide (iv) Molybdenum blue sol. |
| 6 | Study of the coagulation of the hydrophobic solution with monovalent, bivalent and trivalent counter ions and find out their coagulation value. |
| 7 | Determination of the heat of neutralization of weak acid (say acetic acid) and calculate its heat of ionization. |
| 8 | Determination of the solubility of benzoic acid and heat of dissolution. |
| 9 | Demonstration: To determine the viscosity coefficient of a given solution by Ostwald Viscometer. |
| 10 | Determination of the heat of solution of two ionic compounds: $NH_4Cl$ and $CaCl_2$. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | Advanced Physical Chemistry by Prof. Gurdeep Raj, $4^{th}$ edition, Publisher: Krishna Prakashan Media, 2016. |
| 2 | Principles of Physical Chemistry by Puri, Sharma and Pathania, $47^{th}$ edition, Publisher: Vishal Publishing Co., 2017. |
| 3 | Atkins' Physical Chemistry by Atkins and de Paula, $8^{th}$ edition, Publisher: Sterling Book Centre, 2009. |
| 4 | Essentials of Physical Chemistry by Bahl, Tuli and Bahl, $28^{th}$ Edition, Publisher: S Chand Publishing, 2020. |
| 5 | Engineering Chemistry by Jain and Jain, $15^{th}$ edition, Publisher: Dhanpat Rai Publishing Company, 2015. |

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# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – I (Ind. Chem.), Semester – I<br>FUNDAMENTALS OF INORGANIC CHEMISTRY<br>IC103 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Understand the trends, anomalous behaviors, and properties of s- and p-block elements. |
| CO2 | Apply the preparation and industrial applications of selected inorganic compounds. |
| CO3 | Analyze electronic spectra of coordination compounds. |
| CO4 | Evaluate the electronic spectra and magnetic behavior of transition metal complexes. |
| CO5 | Create a comparative assessment of lanthanoids and actinoids including their separation techniques. |

| 2. | Syllabus | |
|---|---|---|
| | **CHEMISTRY OF s- and p-BLOCK ELEMENTS** | **(15 Hours)** |
| | The general trends in the chemistry of s block elements; describe the trends in physical and chemical properties of group 1 & 2 elements. Anomalous behavior of Li and Be. Manufacturing process, properties and industrial applications of sodium and calcium compounds– NaOH, $Na_2CO_3$, $NaHCO_3$, $CaCO_3$, $Ca(OH)_2$.<br>The general trends in the chemistry of p block elements; describe the trends in physical and chemical properties of group 13-17 elements, Anomalous behavior of boron. Group trends with reference to size, and oxidation states and in compounds such as hydrides, oxides, oxyacids, halides and complexes. Preparation, properties of Borax, Orthoboric acid, Diboranes and Boron nitrides its oxidizing behaviour. Structure of silicate, minerals and silicon. | |
| | **PROPERTIES OF TRANSITION METALS** | **(05 Hours)** |
| | Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$. | |
| | **SPECTRA & MAGNETISM OF TRANSITION METAL COMPLEXES** | **(18 Hours)** |
| | The energy terms, coupling schemes, spin-spin coupling, orbital coupling, spin-orbital coupling, R-S coupling, J-J coupling scheme, selection rules, and relaxation of selection rules. Energy levels in an atom, Calculation of the number of the microstates Determining the Ground State, Term Symbols, Terms-Hunds Rule, Orgel diagrams for $d^1$ to $d^9$ systems, Electronic spectra of $[Ti(H_2O)_6]^{3+}$, $[Cu(H_2O)_6]^{2+}$, $[V(H_2O)_6]^{3+}$, $[Ni(H_2O)_6]^{2+}$, $[CoF_6]^{3-}$, $[CoCl_4]^{2-}$ and $[NiCl_4]^{2-}$ complexes, Charge transfer spectra, electronic absorption spectra of spin paired complexes, Jahn-Tellar effect and electronic spectra of complexes; properties of paramagnetic complexes, magnetic moment, anti-ferromagnetism and ferromagnetism. | |
| | **LANTHANOIDS AND ACTINIDES** | **(07 Hours)** |
| | General properties (oxidation states, colour, ionic radii (Lanthanoid contraction) separation of lanthanoids and actinides by various methods, preparation of trans-uranic elements, applications of lanthanoids and actinides. | |

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## B.Tech. in Industrial Chemistry

| | | |
|---|---|---|
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| **3.** | **Practical** |
|---|---|
| | Inorganic qualitative analysis of unknown salts. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: $CO_3^{2-}$ , $NO_2$ - , $S^{2-}$ , $SO_3^{2-}$ ,$S_2O_3^{2-}$ , $CH_3COO^-$ , $F^-$ ,$Cl^-$ , $Br^-$ , $I^-$ , $NO_3^-$ , $BO_3^{3-}$ , $C_2O_4^{2-}$ , $PO_4^{3-}$ , $NH_4^+$ , $K^+$ , $Pb^{2+}$ , $Cu^{2+}$ , $Bi^{3+}$ , $Sn^{2+}$ , $Fe^{3+}$ , $Al^{3+}$ , $Cr^{3+}$ , $Zn^{2+}$ , $Mn^{2+}$ , $Co^{2+}$ , $Ni^{2+}$ , $Ba^{2+}$, $Sr^{2+}$ , $Ca^{2+}$ ,$Mg^{2+}$. |
| | Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:<br>1. Ni (II) and Co (II)<br>2. Cu(II) and Cd(II) |

| **4.** | **Books Recommended** |
|---|---|
| 1 | J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th Edition, Pearson Education, London, 2006. |
| 2 | Shriver D. E.,Atkins P. W., Inorganic Chemistry, Oxford University Press,5thEdn. |
| 3 | Concise Inorganic Chemistry J. D. Lee, 5th Edition (1996), Chapman & Hall, London. 2. |
| 4 | Selected Topics in Inorganic Chemistry Wahid U. Malik, G. D. Tuli, R. D. Madan, Publisher, S. Chand, 2006. |
| 5 | Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017. |

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# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – I (Ind. Chem.), Semester – I<br>ENVIRONMENTAL POLLUTION AND WASTE MANAGEMENT<br>IC105 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 03 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Understand the constituents and working of ecological and biogeochemical cycles. |
| CO2 | Learn the various aspects of atmospheric processes. |
| CO3 | Differentiate between various types of environmental pollution along with their impacts and regulatory standards. |
| CO4 | Interpret the global environmental issues. |
| CO5 | Analyse the concepts of various types of environmental and waste management. |

| 2. | Syllabus | |
|---|---|---|
| | **ECOLOGY AND ENVIRONMENTAL SCIENCE** | **(09 Hours)** |
| | Principles of ecosystem functioning and biodiversity, Biochemical Cycling of Nutrients, Trace Metals and Organic Matter, Biological Pump; Primary and Secondary Biological Productivity, Air-sea Exchange of Biogenic Dissolved Gases, Inertial Currents, Geostrophic Motion, Air-Sea Surface Fluxes, Wind-driven Circulation, Ekman and Sverdrup Transports; Storm Surges, Tides, Tropical Cyclones, Tsunamis and Wind Waves, Eddies and Gyres, Eastern and Western Boundary Currents, Equatorial Currents, Indian Ocean Current Systems, Thermohaline Circulation, Marine Ecology, environmental challenges | |
| | **ATMOSPHERIC SCIENCE** | **(08 Hours)** |
| | Vertical Structure and Composition of the Atmosphere, Blackbody Radiation and Radiation Balance, Heat Transfer in the Atmosphere, Greenhouse Effect, Cloud Type, Humidity in the Atmosphere, Atmospheric Stability, Weather and Climate, Coriolis Forces, Geostrophic, Gradient and Cyclostrophic Balances, Circulations and Vorticity, General Circulation in the Atmosphere. | |
| | **AIR, WATER AND NOISE POLLUTION** | **(06 Hours)** |
| | Sources, types and impacts of air, water and noise pollution, Salient features of Water Act-1974 Salient features of Air Act-1981, CPCB standards with respect to noise in ambient air, Prevention and control of air, water and noise pollution. | |
| | **SOLID AND HAZARDOUS WASTE** | **(07 Hours)** |
| | Sources, types and impacts of solid and hazardous waste, Strategies for managing and disposing of solid and hazardous waste, Regulations for handling of chemical waste, radioactive waste, industrial waste, construction waste and electronic waste. | |
| | **ENVIRONMENTAL MANAGEMENT** | **(07 Hours)** |
| | Principles and practices of environmental management, Sustainability, sustainable development and SDGs, Strategies for promoting sustainability, minimizing environmental impacts, Environmental audit, Regional policy levels, Location of industries, Environmental clearance (EIA) procedure in India, Resettlement and rehabilitation issues. | |
| | **GLOBAL ENVIRONMENTAL ISSUES & TREATIES** | **(08 Hours)** |

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| | |
|---|---|
| | global warming, ozone depletion, acid rain, hazardous waste, Climate change and its impacts on ecosystems and human societies, International environmental treaties and protocols such as Stockholm Conference, Ramsar Convention, Montreal Protocol, Rio Earth Summit, Kyoto Summit. Inter-governmental Panel on Climate Change (IPCC), United Nations Framework Convention on Climate Change (UNFCCC-1992), COP-26 (The Glasgow Climate Pact), COP-27. |
| | **(Total Contact Time: 45 Hours)** |

| 3. | **Books Recommended** |
|---|---|
| 1 | D. B. Botkin & E. A. Akeller, Environmental Science: Earth as a Living Planet, 8th Edition, John Wiley & Sons, Hoboken, NJ, 2011. |
| 2 | R. Rajagopalan, Environmental Studies: From crisis to cure, Oxford University Press, New Delhi, 2016. |
| 3 | B. Joseph, Environmental Studies, McGraw Hill Education, Chennai, 2017. |
| 4 | S. K. Dhameja, Environmental Studies, S. K. Kataria & Sons, New Delhi, 2021. |
| 5 | U. K. Khare, Basics of Environmental Studies, McGraw Hill Education, New Delhi, 2011. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
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| B. Tech. – I (Ind. Chem.), Semester – I | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **MATHEMATICS FOR CHEMISTRY**<br>**MA121** | | **3** | **1** | **0** | **04** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Solve successive differentiations with its applications to different series expansions. |
| CO2 | Apply partial differentiation to find series expansion with error approximations, extremals and jacobians. |
| CO3 | Trace curves in cartesian, polar, and parametric forms. |
| CO4 | Solve first-order ordinary differential equations with its applications to real world problems. |
| CO5 | Analyse the linear systems of algebraic equation with different approach. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **DIFFERENTIAL CALCULUS** | **(10 Hours)** |
| | Differentiation of Hyperbolic and Inverse Hyperbolic functions. Successive Differentiation, standard forms, Leibnitz's theorem and applications, Power series, Expansion of functions, Taylor's and Maclaurin's series. Curvature, Radius of curvature for Cartesian curve with application. | |
| | **PARTIAL DIFFERENTIATION** | **(10 Hours)** |
| | Partial differentiation, Euler's theorem for homogeneous function, Modified Euler's theorem, Taylor's and Maclaurin's series for two variables. Tangent plane and Normal line, Error and Approximation, Jacobians with properties, Extreme values of function of two variables, Lagrange's methods of undetermined multipliers. | |
| | **CURVE TRACING** | **(05 Hours)** |
| | Cartesian, polar and parametric for of standard curves. | |
| | **ORDINARY DIFFERENTIAL EQUATION** | **(08 Hours)** |
| | Reorientation of the differential equation first order first degree, exact differential equation and Integrating factors, Solution of homogenous equations higher order, complementary functions, Particular Integrals, Linear differential equation with variable coefficient | |
| | **APPLICATION OF DIFFERENTIAL EQUATION (MATHEMATICAL MODELLING)** | **(07 Hours)** |
| | Modelling of Real-world problems, particularly Chemical Systems, the spread of epidemic (SI, SIS, SIR), Newton's Law of cooling, Single compartment modelling, Bending of beam models. | |
| | **SYSTEM OF LINEAR ALGEBRAIC EQUATION** | **(05 Hours)** |
| | Linear systems, Elementary row, and column transformation, the rank of a matrix, consistency of the linear system of equations, Linear Independence and Dependence of vectors, Gauss Elimination method, Gauss-Jorden Method, Gauss-Jacobi Iteration Method. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |

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| | |
|---|---|
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** |

| **3.** | **Tutorials** |
|---|---|
| 1 | Differential calculus -I |
| 2 | Differential calculus -II |
| 3 | Differential calculus -III |
| 4 | Partial differentiation-I |
| 5 | Partial differentiation-II |
| 6 | Curve tracing-I |
| 7 | Curve tracing-II |
| 8 | Ordinary differential equation-I |
| 9 | Ordinary differential equation-II |
| 10 | Ordinary differential equation-III |
| 11 | Application of differential equation-I |
| 12 | Application of differential equation-II |
| 13 | System of linear algebraic equation-I |
| 14 | System of linear algebraic equation-II |

| **4.** | **Books Recommended** |
|---|---|
| 1 | J. Stewart, "Calculus," Thomson Asia, Singapore, 1 January 2012. |
| 2 | P. O'Neil, "Advanced Engineering Mathematics," Thompson, Singapore, Ind. Ed. 2002. |
| 3 | B. Kreyszing, "Advanced Engineering Mathematics," John Wiley & Sons, Singapore, Int. Student Ed. 2015. |
| 4 | Wiley C. R., "Advanced Engineering Mathematics", McGraw Hill Inc., New York Ed. 1993. |
| 5 | Bali and Iyengar. Engg. Mathematics, Laxmi Publications, New Delhi, 2004. |

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## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – I (Ind. Chem.), Semester – I | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **INDIAN VALUE SYSTEM AND SOCIAL CONSCIOUSNESS**<br>**HS120** | | **2** | **0** | **0** | **02** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Interpret the important values that need to be cultivated |
| CO2 | Analyse the cultures depicted in Ramayana, Mahabharata, Jainism and Buddhism |
| CO3 | Review the structure of Indian knowledge system |
| CO4 | Discuss the significance of constitution of India |
| CO5 | Demonstrate social responsibility |

| **2.** | **Syllabus** | |
|---|---|---|
| | **HUMAN VALUES AND CONSCIOUSNESS** | **(08 Hours)** |
| | Human Values Definition and Classification of Values; The Problem of Hierarchy of Values and their Choice; Self-Exploration; 'Basic Human Aspirations; Right understanding, Relationship and Physical Facility; fulfilment of aspirations; Understanding Happiness and Prosperity, Harmony at various levels. What Is Consciousness? ; Can We Build A Conscious Machine?; Levels Of Consciousness; Mind, Matter And Beyond; Holistic Lifestyle; Dealing With Anxiety; Connecting Mind To Brain; Minds, Brains, And Programs. | |
| | **INDIAN CULTURE AND HERITAGE** | **(07 Hours)** |
| | Culture and its salient features: The Vedic - Upanishadic Culture and society, Human aspirations in those societies; Culture in Ramayana and Mahabharata: The Ideal Man and Woman, Concepts Maitri, Karuna, Seela, Vinaya, Kshama, Santi, Anuraga - as exemplified in the stories and anecdotes of the Epics; The Culture of Jainism: Jaina conception of Soul, Karma and liberation, Buddhism as a Humanistic culture; The four Noble truths of Buddhism; Vedanta and Indian Culture | |
| | **INDIAN KNOWLEDGE SYSTEM** | **(08 Hours)** |
| | Indian knowledge as a unique system, Place of Indian knowledge in mankind's evolution, Relevance of Indian knowledge to present day and future of mankind, Nature of Indian Knowledge; Structure of Indian Knowledge: Types of knowledge (para, apara), The scientific and the unscientific, Instruments for gaining and verifying knowledge, Knowledge traditions: Lineages, Instruments - debate, epistemology and pedagogy, The inverted tree - axiomatic, deductive, empirical knowledge, and evolution of knowledge; Disciplines of Study: A brief outline of the subjects, the major contributions and theories along with timelines where relevant: Mathematics; Astronomy; Physical Sciences; Cosmogony; Language studies; Astrology; Moral studies/righteousness; Statecraft and political philosophy | |
| | **INDIAN CONSTITUTION** | **(04 Hours)** |
| | History of Making of the Indian Constitution; Philosophy of the Indian Constitution: Preamble; Salient Features; Contours of Constitutional Rights & Duties; Organs of Governance: Parliament; Composition; Qualifications and Disqualifications; Powers and Functions | |
| | **SOCIAL RESPONSIBILITY** | **(03 Hours)** |

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| | |
|---|---|
| | Social Responsibility: Meaning and Importance, Different Approaches of Social Responsibility. Social Responsibility of Business towards different Stakeholders. Evolution and Legislation of CSR in India. |
| | **(Total Contact Time: 30 Hours)** |

| **3.** | **Books Recommended** |
|---|---|
| 1 | D. K. Chaturvedi, Professional Ethics Values and Consciousness, Ane Books Pvt. Ltd., 2023. |
| 2 | R.R. Gaur, R Sangal, G. P.Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010. |
| 3 | A.N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004. |
| 4 | P R Rao, Indian Heritage and Culture, Sterling Publishers Pvt. Ltd, 1988. |
| 5 | D. Singh, Indian Heritage and Culture, APH Publishing Corporation, 1998. |
| 6 | D. K. Chaturvedi, Professional Ethics Values and Consciousness, Ane Books Pvt. Ltd., 2023. |
| 7 | R.R. Gaur, R Sangal, G. P.Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010. |
| 8 | A.N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – I (Ind. Chem.), Semester – I | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **ENGINEERING DRAWING**<br>**ME110** | | **2** | **0** | **4** | **04** |

| 1. | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | To read, understand and apply the knowledge of orthographic projections (production- related features and instructions) in the manufacturing industry, process industry and other allied engineering applications. |
| CO2 | To communicate with globally recognized engineers of different disciplines of engineering for research and development activities. |
| CO3 | To get knowledge of projections and sections of different solid objects |
| CO4 | To perceive the idea of sectional view and its advantages of it. |
| CO5 | To apply the concept of intersections of solids for various engineering applications |
| CO6 | To create the image of three-dimensional figures with the help of isometric projections |

| 2. | **Syllabus** | |
|---|---|---|
| | **Introduction** | **(01 Hours)** |
| | Introduction: Importance of Engineering Drawing, drawing instruments and materials, B.I.S. and IS Conventions, First angle and third angle projection method. | |
| | **ENGINEERING CURVES** | **(03 Hours)** |
| | Classification of engineering curves, construction of conics, cycloidal, Involutes and spirals curves. | |
| | **PROJECTION OF POINTS, LINES AND PLANES** | **(04 Hours)** |
| | Introduction to principal planes of projection, Projections of the points located in the same and different quadrants, projection of lines with its inclination to the reference planes, true length of the lines and its inclination with reference planes, projection of planes with its inclination with two reference planes, concept of an auxiliary plane method for projection of planes. | |
| | **PROJECTION AND SECTION OF SOLIDS** | **(03 Hours)** |
| | Classification of the solids, projections of the solids like cylinder, cone, pyramid and prism with its inclination to two reference planes, Section of such solids and true shape of the section | |
| | **DEVELOPMENT OF THE LATERAL SURFACES** | **(03 Hours)** |
| | Method of development, parallel line development, radial line development, developments of cylinder, cone, prism, pyramid, true length of edges - oblique surface. cylinder, cone, prism, pyramid, true length of edges - oblique surface. | |
| | **PENETRATION CURVE** | **(04 Hours)** |
| | Classification, line of interaction, line/generator method and section plane method; intersection of two prisms, two cylinders, interaction of cone and cylinder, pyramid with prism, surface development. | |
| | **ORTHOGRAPHIC PROJECTIONS** | **(04 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | Projections from a pictorial view of the object on the principal planes for view from front, top, and side using a first and third angle of the projection method | |
| | **ISOMETRIC PROJECTIONS** | **(04 Hours)** |
| | Terminology, isometric scale, construction of isometric view and isometric projection, isometric axes, and lines | |
| | **INTRODUCTION TO COMPUTER-AIDED DRAFTING** | **(04 Hours)** |
| | Introduction of the drafting and modeling software and demonstration of it's the application on latest machines. | |
| | **Practical will be based on the coverage of the above topics separately** | **(60 Hours)** |
| | **(Total Contact Time: 30 Hours + 60 Hours= 90 Hours)** | |

| **3.** | **Tutorials** |
|---|---|
| 1 | Orthographic views |
| 2 | Isometric views |
| 3 | Engineering curves |
| 4 | Projection of points and planes |
| 5 | Projection of solids |
| 6 | Section of solids |
| 7 | Penetration curve and surface development |
| 8 | Demonstration of computer-aided drafting and demonstration of its application in the latest machines. |
| 9 | Determination of cloud point and pour point of biodiesel and its comparison with diesel |

| 4**.** | **Books Recommended** |
|---|---|
| 1 | Bhatt, N.D.,2023. Engineering Drawing. Charotar Publishing House Pvt. Limited |
| 2 | Shah P. J., 2013, Engineering Graphics, S. Chand and Company. |
| 3 | Basant Agrawal, C M Agrawal, 2019, Engineering Drawing, McGraw Hill Education (India) Private Limited |
| 4 | S.R. Singhal, O. P. Saxena, 2014, Engineering Drawing, Asian Publisher |
| 5 | R. K. Dhawan, 2019, A Textbook of Engineering Drawing, S Chand Publishing |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

# B. Tech.-I (Ind. Chem.) (Sem. – II)

| Sr. No. | Subject | Code | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---|---|---|---|---|---|
| | **Second Semester (1st year of B. Tech. Ind. Chem.)** | | | | |
| 1 | Fundamentals of Organic Chemistry | IC102 | 3-0-2 | 4 | 85 |
| 2 | Basic Industrial Chemistry | CY104 | 3-0-2 | 4 | 85 |
| 3 | Fundamentals of Computer and Programming | CS110 | 3-0-2 | 4 | 85 |
| 4 | English and Professional Communication | HS110 | 3-1-0 | 4 | 70 |
| 5 | Numerical Methods in Chemical Engineering | CH106 | 3-1-0 | 4 | 70 |
| | | | **Total** | **20** | **395** |
| 6 | Vocational Training / Professional Experience (Optional) (Mandatory for Exit) | CYV02 / CYP02 | 0-0-10 | 5 | 200 (20 x 10) |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B.Tech.- I (Ind. Chem.), Semester – II<br>FUNDAMENTALS OF ORGANIC CHEMISTRY<br>IC102 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Demonstrate the reactivity of aromatic compounds. |
| CO2 | Acquire the basic concepts and knowledge of various substitution reactions. |
| CO3 | Gain the knowledge in the reaction mechanisms and how the factors are influenced in substitution and elimination reactions. |
| CO4 | Understand addition reaction mechanisms. |
| CO5 | Apply the practical knowledge of stereochemistry for organic compounds. |

| 2. | Syllabus | |
|---|---|---|
| | **REACTION INTERMEDIATES** | **(06 Hours)** |
| | Reactive intermediates, electrophiles and nucleophiles, free radical, carbonium ion and carbanion, carbenes, nitrenes, and arynes. Types of organic reactions: stepwise, ionic and free radical mechanisms, single step concerted mechanism, addition, substitution, elimination and rearrangement, method of determining mechanisms (identification of product, isotope effects, cross over experiments and determination of reaction intermediates). | |
| | **SUBSTITUTION REACTIONS** | **(15 Hours)** |
| | Electrophilic substitution reactions: Theory of activity and deactivity effects, orientation and reactivity, *ortho* and *para* ratio, Ipso effect, calculation of partial rate factor, quantitative treatment of reactivity in substrates and electrophiles.<br>Nucleophilic substitution reactions: $SN^2$, $SN^1$, Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon. Reactivity effects of structure, attacking nucleophile, leaving group and reaction mechanism, solvent effect, regioselectivity. Phase transfer catalyst. $SN_i$ mechanism, neighbouring group mechanism, neighbouring group participation by π- and σ- bonds, -OH, $-NH_2$, -COO, -halogen and aromatic ring. $ArSN^1$ mechanism, reactivity effect of substrate structure, leaving group and attacking nucleophile. | |
| | **ADDITION AND ELIMINATION REACTIONS** | **(12 Hours)** |
| | Addition reactions: Electrophilic and free radical addition (reactions of alkene, dienes and alkyne). Nucleophilic addition (Reactions of aldehyde and ketones).<br>Elimination reactions: $E_1$, $E_2$ and $E_1CB$ mechanism and their spectrum orientation of the double bond, reactivity effects of substrate structures, attacking base, leaving groups and the medium and orientation in pyrolytic elimination. | |
| | **STEREOCHEMISTRY** | **(12 Hours)** |
| | Conformations and configurations of alkanes and cycloalkanes; Prochirality, chirality, enantiomers, diastereomers, threo- and erythro- diastereomers, meso compounds, resolution of enantiomers, retention and racemization. Relative and absolute configuration, sequence rules, D and L systems of nomenclature and R and S systems of nomenclature (one and two chiral centres). Determination of | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | composition of enantiomers and diastereomers. Geometric isomerism: determination of configuration of geometric isomers E and Z systems of nomenclature, geometric isomers of oximes and alicylic compounds. stereospecific and stereoselective synthesis. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| **3.** | **Practical will be based on** |
|---|---|
| 1 | Systematic qualitative analysis of aromatic carboxylic acid. |
| 2 | Systematic qualitative analysis of aromatic primary amine. |
| 3 | Systematic qualitative analysis of hydrocarbon. |
| 4 | Systematic qualitative analysis of monosaccharide. |
| 5 | Systematic qualitative analysis of phenolic compound. |
| 6 | Systematic qualitative analysis of aromatic nitro compound. |
| 7 | Systematic qualitative analysis of carbonyl compound. |
| 8 | Systematic qualitative analysis of neutral compound. |
| 9 | Systematic qualitative analysis of nitro substituted aromatic primary amine. |
| 10 | Systematic qualitative analysis of unsaturated carboxylic acid. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | M. B. Smith, J. March, *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*, 6th Edition, Wiley-Interscience, 2012. |
| 2 | P. Y. Bruice, Organic Chemistry, 3rd Edition, International Edition, Prentice-Hall, New Jersey, 2009. |
| 3 | J. Clayden, S. Warren, N. Greeves, P. Wothers**,** *Organic Chemistry*, 2nd Edition, Oxford University Press, 2012. |
| 4 | E. L. Eliel, S. H. Wilen, Stereochemistry of Organic Compounds, 1st Edition, John Wiley & Sons, New York, 2008 |
| 5 | W. Carruthers, I. Coldham, Some Modern Methods of Organic Synthesis, Cambridge University Press, Cambridge, 4th Edition, 2015. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B.Tech.- I (Ind. Chem.), Semester – II<br>BASIC INDUSTRIAL CHEMISTRY<br>CY104 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Impart knowledge in fundamental aspects of industrial chemistry. |
| CO2 | Acquire knowledge on material and energy balance. |
| CO3 | Describe the composition of different types of glasses. |
| CO4 | Understand different types of ceramics and their uses. |
| CO5 | Describe the steps involved in the manufacturing of cement. |

| 2. | Syllabus | |
|---|---|---|
| | **BASIC CONCEPT** | **(10 Hours)** |
| | Unit operations and unit processes, preparation of flow diagrams, concepts of material balance and energy balance. | |
| | **GLASS** | **(09 Hours)** |
| | Properties and classification silicate and non-silicate glasses. Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, safety glass, borosilicate glass, fluorosilicate, colored glass, photosensitive glass. | |
| | **CERAMICS** | **(09 Hours)** |
| | Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications. | |
| | **CEMENT** | **(08 Hours)** |
| | Classification of cement, ingredients and their role, manufacture of cement and the setting process, quick setting cements. | |
| | **EXPLOSIVES** | **(09 Hours)** |
| | Properties and classification of explosives, preparation and explosive properties of nitrocellulose, TNT, PETN, cyclonite (RDX). Introduction of rocket propellant. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| 3. | Practical will be based on |
|---|---|
| 1 | To determine the loss on igniting the cement sample. |
| 2 | To determination the total insoluble residue in the cement sample. |
| 3 | To determine the total silica in the given sample. |
| 4 | To determine the total oxides (Sesquioxides $Fe_2O_3$ + $Al_2O_3$) in the given sample. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| 5 | To determine the amount of lime (CaO) in the given sample. |
| 6 | To determine the amount of Magnesia (MgO) in the given sample. |
| 7 | To determine the amount of Iron as $Fe_2O_3$ in the given sample. |
| 8 | Preparation of nitro-cellulose. |
| 9 | Synthesis using different unit processes. |
| 10 | Synthesis using different unit processes. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | Process calculations (Stoichiommetry) K.A. Ghavane (Nirali Prakashan). |
| 2 | Basic Principles & Calculations in Chemical Engineering, David M. Himmelblau (Prentice Hall). |
| 3 | J. A. Kent: Riegelfs Handbook of Industrial Chemistry, CBS Publishers, New Delhi. |
| 4 | O. P. Vermani, A. K. Narula: Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi. |
| 5 | S. C. Bhatia: Chemical Process Industries, Vol. I & II, CBS Publishers, New Delhi. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B.Tech.- I (Ind. Chem.), Semester – II<br>FUNDAMENTALS OF COMPUTER AND PROGRAMMING<br>CS110 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Acquire knowledge about computer architecture, network and software development. |
| CO2 | Install an operating system and configure the network along with programming skills to solve the given problem. |
| CO3 | Debug network and operating system related issues and analyse the given problem. |
| CO4 | Evaluate programming solutions with different aspects. |
| CO5 | Design and develop solution for given problems. |

| 2. | Syllabus | |
|---|---|---|
| | **INTRODUCTION TO COMPUTER AND ITS ARCHITECTURE** | **(02 Hours)** |
| | Introduction and Characteristics, Computer Architecture, Generations, Classifications, Applications, Central Processing Unit and Memory, Communication between various Units, Processor Speed, Multiprocessor System, Peripheral Buses, Motherboard Demonstration. | |
| | **MEMORY AND VARIOUS INPUT AND OUTPUT DEVICES** | **(02 Hours)** |
| | Introduction to Memory, Input and Output Devices, Memory Hierarchy, Primary Memory and its Types, Secondary Memory, Classification of Secondary Memory, Various Secondary Storage Devices and their Functioning. | |
| | **NUMBER SYSTEMS** | **(01 Hour)** |
| | Introduction and type of Number System, Conversion between Number System, Arithmetic Operations in different Number System, Signed and Unsigned Number System. | |
| | **INTRODUCTION TO SYSTEM SOFTWARES AND PROGRAMMING LANGUAGES** | **(04 Hours)** |
| | Classification of Computer Languages, Introduction of Operating System, Evolution, Type and Function of OS, Unix Commands, Evolution and Classification of programming Language, Feature and Selection of good Programming Language, Development of Program, Algorithm and Flowchart, Program Testing and Debugging, Program Documentation and Paradigms, Characteristics of good Program. | |
| | **WINDOWS OPERATING SYSTEM AND ITS ENVIRONMENT** | **(02 Hours)** |
| | Introduction to GUI based OS, Configuration, Setup, Services, Network Configuration. | |
| | **LINUX OPERATING SYSTEM AND ITS ENVIRONMENT** | **(02 Hours)** |
| | Introduction to Unix based OS, Configuration, Setup, Services, Scripting, Network Configuration. | |
| | **DEBUGGING TOOLS AND COMPILER OPTION** | **(04 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | Different Debugging tools, Commands, Memory dump, Register and Variable Tracking, Instruction and Function level debugging, Compiler Options, Profile Generation. | |
| | **DATA COMMUNICATION, COMPUTER NETWORK AND INTERNET BASICS** | **(02 Hours)** |
| | Data Communication and Transmission media, Multiplexing and Switching, Computer Network and Network Topology, Communication Protocols and Network Devices, Evolution and Basic Internet Term, Getting Connected to Internet and Internet Application, Email and its working, Searching the Web, Languages of Internet, Internet and Viruses. | |
| | **PROGRAMMING USING 'C' LANGUAGE - INTRODUCTION** | **(06 Hours)** |
| | Characteristics of C Language, Identifiers and Keywords, Data Types Constants and Variables, Declarations and Statements, Representation of Expressions, Classification of Operators and Library Functions for Data Input and Output Statements, Formatted Input and Output Statements. | |
| | **PROGRAMMING USING 'C' LANGUAGE - CONTROL STATEMENTS, STRUCTURES, ARRAYS, POINTERS** | **(12 Hours)** |
| | Conditional Control Statements, Loop Control Statements, One Dimensional Array of Numbers and Characters, Two-Dimensional Array, Introduction and Development of User Defined Functions, Different Types of Variables and Parameters, Structure and Union, Introduction to Pointers, Pointer Arithmetic, Array of Pointers, Pointers and Functions, Pointers and structures, File Handling Operations | |
| | **PROGRAMMING USING 'C' LANGUAGE - FUNCTIONS** | **(06 Hours)** |
| | Functions, Passing the arguments, Return values from functions, Recursion, Header Files Design, File handling operations, Read and Write to Secondary Devices, Read and Write to Input and Output Ports. | |
| | **PROGRAMMING USING 'C' LANGUAGE - GRAPHICS, DEBUGGING** | **(02 Hours)** |
| | Include Graphics Library, Debugging, Linking, Compilation Option for Optimization, Make file. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| **3.** | **Practical will be based on** |
|---|---|
| 1 | Basic commands of Windows and Linux. |
| 2 | Basic commands of Windows and Linux. |
| 3 | Flow chart drawing and writing pseudo steps or algorithms steps. |
| 4 | Flow chart drawing and writing pseudo steps or algorithms steps. |
| 5 | Programming for logic development using different control statements. |
| 6 | Programming for logic development using different control statements. |
| 7 | Programming for familiarity with control statement, array, pointers. |
| 8 | Programming for familiarity with control statement, array, pointers. |
| 9 | Programming using structures, pointers, programming using functions. |
| 10 | Programming using structures, pointers, programming using functions. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| **4.** | **Books Recommended** |
|---|---|
| 1 | "Introduction to Computer Science", Fourth Impression, Pearson Education, ITL Education Solutions Limited, 2009. |
| 2 | Gottfried B.S., "Programming with C Schaum's outline Series", Outline Series, 2nd Edition, Tata McGraw-Hill, 2006. |
| 3 | Brian W. Kernighan, Dennis M. Ritchie, "The C Programming language", 2nd Edition, Prentice Hall PTR publication, 1988. |
| 4 | E. Balagurusamy, "Programming in ANSI C", 6th Edition, Tata Mc-Graw Hill, 2012. |
| 5 | PradipDey, "Programming in C", 2nd Edition, Oxford University Press, 2012. |

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# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B.Tech.- I (Ind. Chem.), Semester – II<br>ENGLISH AND PROFESSIONAL COMMUNICATION<br>HS110 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Show enhanced reception towards the use of English language. |
| CO2 | Choose and employ appropriate words for professional communication. |
| CO3 | Develop sentences and text in English coherently and formally. |
| CO4 | Demonstrate overall improvement in oral communication |
| CO5 | Analyze and infer from written and oral messages. |

| 2. | Syllabus | |
|---|---|---|
| | **COMMUNICATION** | **(05 Hours)** |
| | Introduction to Communication, Different forms of Communication, Barriers to Communication and some remedies, Non-Verbal Communication - Types, Non-Verbal Communication in Intercultural Context. | |
| | **VOCABULARY AND USAGE OF WORDS** | **(05 Hours)** |
| | Common Errors, Synonyms, Antonyms, Homophones, and Homonyms; One Word Substitution; Misappropriations; Indianisms; Redundant Words. | |
| | **LANGUAGE THROUGH LITERATURE** | **(09 Hours)** |
| | Selected short stories, essays, and poems to discuss nuances of English language. | |
| | **LISTENING AND READING SKILLS** | **(06 Hours)** |
| | Types of listening, Modes of Listening-Active and Passive, Listening and note taking practice, Practice and activities.<br>Reading Comprehension (unseen passage- literary /scientific / technical) Skimming and scanning, fact vs opinion, Comprehension practice. | |
| | **SPEAKING SKILLS** | **(10 Hours)** |
| | Effective Speaking, JAM, Presentation Skills- types, preparation and practice. Interviews- types, preparation and mock interview; Group Discussion- types, preparation and practice. | |
| | **WRITING SKILLS** | **(10 Hours)** |
| | Prerequisites of effective writing, Memo-types, Letter Writing- types, Email etiquette and Netiquette, Resume-types, Report Writing and its types, Editing. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| | |
|---|---|
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** |

| **3.** | **Tutorials will be based on** |
|---|---|
| 1 | Letter and Resume. |
| 2 | Group Discussion. |
| 3 | Presentation Skills (Individual). |
| 4 | Role Play on Nonverbal communication. |
| 5 | Group Presentation. |
| 6 | Debate. |
| 7 | Body language and intercultural communication. |
| 8 | Listening Activities. |
| 9 | Editing. |
| 10 | Report Writing. |
| 11 | Mock Interviews. |
| 12 | JAM. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | Kumar, Sanjay and Pushp, Lata. Communication Skills, 2nd Edition, OUP, New Delhi, 2015. |
| 2 | Raman, Meenakshi & Sharma Sangeeta. Technical Communication Principles and Practice, 3rd Edition, OUP, New Delhi, 2015. |
| 3 | Raymond V. Lesikar and Marie E Flatley. Basic Business Communication skills for Empowering the Internet generation. Tata McGraw Hill publishing company limited. New Delhi 2005. |
| 4 | Courtland L. Bovee, John V. Thill, and Mukesh Chaturvedi. "Business Communication Today." Ninth Edition. Pearson, 2009. |
| 5 | Mike Markel. "Practical Strategies for Technical Communication," Bedford/ St. Martin's Second Edition, 2016 |
| 6 | Laura J. Gurak and John M. Lannon. "Strategies for Technical Communication in the Workplace," Pearson, 2013. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B.Tech.- I (Industrial Chemistry), Semester – II<br>NUMERICAL METHODS IN CHEMICAL ENGINEERING<br>CH106 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Apply curve fitting techniques to approximate a function in interpolating and extrapolating a given data. |
| CO2 | Analyze the different samples of data at different level of significance using various hypothesis testing. |
| CO3 | Solve system of linear and non-linear equations using direct and iterative methods. |
| CO4 | Compare various numerical methods for solving ordinary and partial differential equations. |
| CO5 | Solve chemical processes and design problems. |

| 2. | Syllabus | |
|---|---|---|
| | **INTERPRETATION OF ENGINEERING DATA** | **(08 Hours)** |
| | Curve fitting: Least square regression. Interpolation: Newton's Forward/ Backward interpolation, Lagrange's interpolation and their applications. | |
| | **ENGINEERING STATISTICS** | **(10 Hours)** |
| | Errors and its propagation. Significance tests: Null hypothesis, alternative hypothesis, p-value, Type-I and Type-II error, confidence interval, central limit theorem. Z-test, t-test, f-test, chi square test, etc. Analysis of variance (ANOVA). | |
| | **NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS** | **(10 Hours)** |
| | Linear systems of equations, Solutions by Cramer's Rule, Matrix methods, Gauss-Jordan, Gauss Elimination, Gauss Jacobi, Gauss-Seidel and Relation methods. Non-linear equations: Bisection, Regula-falsi, Secant and Newton- Raphson methods. | |
| | **NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS** | **(10 Hours)** |
| | Initial value problems for ordinary differential equations: Euler's, Runge-Kutta and Milne's predictor-corrector methods. Boundary value problems: Finite difference methods, Partial differential equations: Solutions of elliptic, parabolic and hyperbolic types of equations. | |
| | **FORMULATION OF PHYSICAL PROBLEMS** | **(07 Hours)** |
| | Mathematical statement and representation of problems, Exponential growth and decay, Newton's law of cooling, Batch reaction kinetics, Radial heat transfer through a cylindrical conductor, salt accumulation in a stirred tank. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

| | |
|---|---|
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** |

| **3.** | **Tutorials will be based on** |
|---|---|
| 1 | Tutorial is based using curve fitting methods. |
| 2 | Tutorial is based on interpolation methods. |
| 3 | Tutorial is related to tests of significance |
| 4 | Tutorial based on ANOVA. |
| 5 | Tutorial is based on finding solutions to linear equations by direct methods. |
| 6 | Tutorial is based on finding solutions to non-linear equations by iterative methods. |
| 7 | Tutorial is based on finding solutions to initial value problems. |
| 8 | Tutorial is based on finding solutions to boundary value problems. |
| 9 | Tutorial is based on formulation of physical problems. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | S.S. Sastry, Introductory Methods of Numerical Analysis, 5th Edition, PHI Learning Private Limited, 2012. |
| 2 | M. K. Jain, S.R.K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computations, 8th Edition, New Age International publications, 2022. |
| 3 | Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, 8th Edition, Mc. Graw Hill, 2021 |
| 4 | Pradeep Ahuja, Introduction to Numerical Methods in Chemical Engineering, 2nd Edition, PHI Learning Private Limited, 2019. |
| 5 | Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., Probability and Statistics for Engineers and Scientists, 9thEdition, Pearson Education, Asia, 2011. |
| 6 | Norman W. Loney, Applied Mathematical Methods for Chemical Engineers, 3rd Edition, CRC Press, 2015. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

# B. Tech.-II (Ind. Chem.) (Sem. – III)

| Sr. No. | Subject | Code | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---|---|---|---|---|---|
| | **Third Semester (2nd year of B. Tech. Ind. Chem.)** | | | | |
| 1 | Industrial Organic Chemistry | IC201 | 3-0-2 | 4 | 85 |
| 2 | Chemical Kinetics and Engineering Thermodynamics | IC203 | 3-0-2 | 4 | 85 |
| 3 | Fundamentals of Quantum Chemistry | IC231 | 3-1-0 | 4 | 70 |
| 4 | Quality Control and Quality Assurance | CY207 | 3-0-0 | 3 | 55 |
| 5 | Fluid Flow Operations | CH203 | 3-1-2 | 5 | 100 |
| | | | **Total** | **20** | **395** |
| 6 | Vocational Training / Professional Experience (Optional) (Mandatory for Exit) | CYV03 / CYP03 | 0-0-10 | 5 | 200 (20 x 10) |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – III<br>INDUSTRIAL ORGANIC CHEMISTRY<br>IC201 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Explain about basic raw materials of various chemical industries. |
| CO2 | Discuss the process flow diagram and various process parameters. |
| CO3 | Explore various synthetic methods of producing industrial chemicals, their applications. |
| CO4 | Memories the basic chemistry of production. |
| CO5 | Able to bridge the gap between classic laboratory chemistry and large-scale reactions. |

| 2. | Syllabus | |
|---|---|---|
| | **INDUSTRIAL ORGANIC CHEMICALS** | **(05 Hours)** |
| | Introduction to chemical industry: An overview, Industrial organic chemicals, sources of organic chemicals. | |
| | **PETROLEUM REFINING PROCESSES AND BASIC ORGANIC CHEMICALS** | **(07 Hours)** |
| | Introduction, Distillation, Hydrotreating, Cracking, Reforming, Ethylene, Propylene, Benzene. | |
| | **CHEMICALS FROM PROPYLENE** | **(07 Hours)** |
| | Oxidation products of propylene, direct and indirect oxidation of propylene, propylene oxide, secondary products of propylene oxide, conversion to acrolein and acrylonitrile. | |
| | **CHEMICALS FROM BENZENE** | **(07 Hours)** |
| | Alkylation and hydrogenation products of Benzene: ethylbenzene, styrene, cumene, oxidation and secondary products of Benzene: Phenol, maleic anhydride. | |
| | **CHEMICALS FROM ACETYLENE** | **(05 Hours)** |
| | Significance of acetylene. utilization of acetylene, manufacture of acetylene. | |
| | **INDUSTRIAL GASES** | **(07 Hours)** |
| | Industrial Gases – Manufacture of hydrogen, oxygen, nitrogen, carbon dioxide, chlorine and sulphur dioxide. | |
| | **INDUSTRIAL SAFETY AND HAZARDS** | **(07 Hours)** |
| | Industrial hazards and safety considerations in chemical industries, mechanical, electrical and chemical hazards, fire and explosion hazards, health hazards, laboratory safety, control of plant hazards, safety practice. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
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| 3. | Practical will be based on |
|---|---|
| 1 | Study of simple distillation and determination of the relative volatility of the binary systems. |
| 2 | To study the rectification characteristic of binary system. |
| 3 | To determine the kinematic viscosity of petroleum sample using Saybolt viscometer. |
| 4 | To determine the kinematic viscosity of petroleum sample using Redwood viscometer. |
| 5 | To determine the Diesel Index of liquid petroleum products. |
| 6 | To study simple distillation by determination of the relative volatility of the binary systems. |
| 7 | To study the rectification characteristic of binary system. |
| 8 | Synthesis of chemicals from Propylene. |
| 9 | Synthesis of chemicals from Benzene. |
| 10 | Synthesis of chemicals from Acetylene. |

| 4. | Books Recommended |
|---|---|
| 1 | Philip J. Chenier, Survey of Industrial Chemistry, Third Edition, Kluwer Academic Publishers, New York, ISBN 0-306-47246-5, 2002. |
| 2 | Mohammad Farhat Ali, Bassam M. El Ali, James G. Speight, Handbook of Industrial Chemistry Organic Chemicals, McGraw-Hill, ISBN 0-07-141037-6, 2005. |
| 3 | Klaus Weissermel, Hans- Jurgen Arpe, Industrial Organic Chemistry, 3rd edition, VCH Publishers, ISBN: 978-3-527-61919-1, May 2008. |
| 4 | Benvenuto, Mark Anthony. Industrial Organic Chemistry, Berlin, Boston: De Gruyter Publisher, ISBN: 9783110494471, 2017. |
| 5 | B. K. Sharma, Industrial Chemistry Part-I & II, Publisher-Krishna Prakashan, 2023. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – III | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **CHEMICAL KINETICS AND ENGINEERING THERMODYNAMICS IC203** | | **3** | **0** | **2** | **04** |

| 1. | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Identify and distinguish various chemical reactions based on their kinetics. |
| CO2 | Interpret rate of reactions through various kinetic theories. |
| CO3 | Calculate the rates of various chemical reactions. |
| CO4 | Analyze the thermodynamic properties of chemical reactions. |
| CO5 | Evaluate the kinetic and thermodynamic applications in chemical industries. |

| 2. | **Syllabus** | |
|---|---|---|
| | **REACTION ORDER AND REACTION MECHANISM** | **(09 Hours)** |
| | Order of a reaction, Molecularity, Integrated rate equations, Zero order reactions, First order reactions, Pseudo-order reactions, Second order reactions, Third order reactions, Half- life of reactions, Methods of determination of order and rate constants, Rate of photochemical reactions, Rates of reversible reactions, concurrent reactions, consecutive reactions, principle of microscopic reversibility, steady state approximation, reaction rates of $NO+O_2$, Saponification of ester, Iodination of acetone, Chain reactions, and Oscillatory reactions. | |
| | **THEORIES ON REACTION RATES** | **(09 Hours)** |
| | Lindemann theory, Kinetics of chain reaction, stationary chain reactions, Non-stationary chain reactions, Activated complex theory, Effect of temperature and pressure on reaction rates, Arrhenius equation, Collision theory, Activation energy, Hinshelwood's theory, Rice-Ramsperger-Kassel theory, Kinetics of catalyzed reactions. | |
| | **REACTOR DESIGN** | **(06 Hours)** |
| | Types of reactors, PFR, CSTR etc., Material & energy balances single ideal reactor, Space time and space-velocity, Holding time, Introduction of non-ideal flow, single reactors, Multiple reactor system, Recycle reactor, Autocatalytic reactions, bio-reactors, Design, scale-up, operation and control of bio-reactors. | |
| | **THERMODYNAMICS** | **(09 Hours)** |
| | Kelvin-Planck and Clausius statements and their equivalence, Entropy; microscopic interpretation of entropy, the principle of increase of entropy, T-S diagrams; Maxwell relations, second law analysis of control volume; third law of thermodynamics, Carnot cycle, Clausius inequality, concept of entropy; microscopic interpretation of entropy, the principle of increase of entropy, T-s diagrams; second law analysis of control volume; availability and irreversibility; third law of thermodynamics | |
| | **ENGINEERING THERMODYNAMICS** | **(12 Hours)** |
| | Heat reservoirs, Heat engines, Refrigeration, Coefficient of Performance (COP), Refrigerator capacity, Vapour-compression cycle, Choice of refrigerant, Air-refrigeration cycle, Carnot vapor | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | cycle, ideal Rankine cycle, Rankine reheat cycle, air-standard Otto cycle, air standard Diesel cycle, air-standard Brayton cycle, Flow Processes, Continuity equation, Energy equation, flow in pipes and nozzles, Ejectors, Compressors, Steam power plant, Internal combustion engines. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| **3.** | **Practical will be based on** |
|---|---|
| 1 | Determination of order and rate constant for the methyl acetate hydrolysis in acidic media. |
| 2 | Determination of order and rate constant for the ethyl acetate hydrolysis in basic media. |
| 3 | Determination the order and rate constant of the reaction between $K_2S_2O_8$ and KI. |
| 4 | Determination of order and rate constant for the decomposition of $H_2O_2$ in presence and absence of catalyst. |
| 5 | Distribution of benzoic acid between benzene and water and find out the distribution co-efficient and decide the molecular state of benzoic Acid in both the solvents. |
| 6 | Determination of CST of phenol+ water system. |
| 7 | Determine the heat of solution of benzoic acid by finding the solubility at two different temperatures. |
| 8 | Determination of saponification value of given oil. |
| 9 | Determination of acid value of a lubricating oil. |
| 10 | Determination of redox potential of a redox system. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | P. Atkins, J. de Paula, J. Keeler, *Physical Chemistry International Edition Eleventh edition,* Oxford University Press, Oxford, UK, 2018. |
| 2 | I. N. Levine, *Physical Chemistry 6th edition*, McGraw Hill, New York, 2011. |
| 3 | K. L. Kapoor, *A Textbook of Physical Chemistry, Thermodynamics and Chemical Equilibrium (SI Units) - Vol. 2 6*th *Edition*, McGraw Hill, New Delhi, India, 2019. |
| 4 | K. L. Kapoor, *A Textbook of Physical Chemistry - Dynamics of Chemical Reactions, Statistical Thermodynamics, Macromolecules and Irreversible Processes, Vol. 5 , 4th Edition*, McGraw Hill, New Delhi, India, 2022. |
| 5 | B. R. Puri, M. S. Pathania, L. R. Sharma, *Principles of Physical Chemistry, 49th Edition*, Vishal Publications, New Delhi, India, 2020. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – III<br>FUNDAMENTALS OF QUANTUM CHEMISTRY<br>IC231 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Memorize the fundamentals of classical quantum chemistry. |
| CO2 | Gain basics of various operators with their applications. |
| CO3 | Calculate eigen values and eigen functions for various systems. |
| CO4 | Solve mathematical problems based on quantum mechanics. |
| CO5 | Learn basics of molecular quantum mechanics. |

| 2. | Syllabus | |
|---|---|---|
| | **BASICS OF QUANTUM** | **(15 Hours)** |
| | Brief Introduction of Classical Mechanics, Failure of Classical Mechanics, Rutherford atomic model, Bohr theory of hydrogen atom, Black body radiation, Planck's theory, Photoelectric effect, Einstein's Quanta, Compton effect, Dual nature of electromagnetic radiation, de Broglie's hypothesis, Wave particle duality, Matter wave, Concept of wave packets, Uncertainty principle and its various mathematical forms. Numericals. | |
| | **QUANTUM MECHANICS** | **(20 Hours)** |
| | Postulates of Quantum Mechanics, Schrödinger wave equation (Time dependent and time independent), Solution of Schrödinger equation as wave function and energy (eigen values and eigen functions), Hermitian operators, Hamiltonian for various systems, Solution of Schrödinger wave equation for Simple systems: 1-D and 3-D box. Numericals. | |
| | **MOLECULAR QUANTUM MECHANICS** | **(10 Hours)** |
| | Molecular orbital theory (MOT), Valence bond theory (VBT), Hybridization, Calculation of the coefficients of AOs used in hybridization, Huckel molecular orbital theory (HMOT) of simple conjugated systems (Ethylene, 1,3-butadiene and benzene). | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** | |

| 3. | Tutorials will be based on |
|---|---|
| 1 | Photoelectric effect. |
| 2 | Compton effect, Dual nature of electromagnetic radiation and de Broglie's hypothesis. |
| 3 | Uncertainty principle and its various mathematical forms. |
| 4 | Eigen values and eigen functions. |
| 5 | Hermitian operators. |
| 6 | Hamiltonian operator. |
| 7 | 1-D Box |

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| | |
|---|---|
| 8 | 3-D Box. |
| 9 | Molecular orbital theory (MOT). |
| 10 | Valence bond theory (VBT) and Hybridization. |
| 11 | Calculation of the coefficients of AOs for sp and $sp^2$ hybridization. |
| 12 | Calculation of the coefficients of AOs for $sp^3$ hybridization. |
| 13 | Calculation of π-electron energy resonance energy for 1,3-butadiene. |
| 14 | Calculation of π-electron energy resonance energy for Benzene |
| 15 | Calculation of π-electron energy resonance energy for Ethylene. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | B. R. Puri, L. R. Sharma, *Principles of Physical Chemistry*, 49th Edition, Vishal Publications, New Delhi, India, 2020. |
| 2 | Donald A. McQuarrie, *Quantum Chemistry*, Viva Student Edition, Viva, New Delhi, India 2016. |
| 3 | M. Reiher, Relativistic Quantum Chemistry: The Fundamental Theory Of Molecular Science, 2nd Edition, John Wiley, Hoboken, New Jersey, US, 2014. |
| 4 | N. Levine, Quantum Chemistry, 7th Edition, Pearson Education India, Chennai, 2016. |
| 5 | S. Maity, N. Ghosh, *Physical Chemistry Practical*, 1st Edition, New Central Book Agency (P) Ltd., India, 2012. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – III | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **QUALITY CONTROL AND QUALITY ASSURANCE**<br>**CY207** | | **3** | **0** | **0** | **03** |

| 1. | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Compare quality control and quality assurance. |
| CO2 | Acquire knowledge on GLP and their application to quality assurance and quality control systems. |
| CO3 | Describe the good manufacturing processes focused on application of quality assurance methods. |
| CO4 | Understand the quality system inspection technique and its application to quality assurance and quality control systems. |
| CO5 | Acquire knowledge of record, data management, ISO guidelines and standards. |

| 2. | **Syllabus** | |
|---|---|---|
| | **FUNDAMENTALS OF QC AND QA** | **(08 Hours)** |
| | Concepts, evolution and scope of quality control and quality assurance, overview of ICH guidelines. | |
| | **GOOD LABORATORY PRACTICES** | **(09 Hours)** |
| | Scope of Good Laboratory Practices (GLP), quality assurance, protocol for conduct of non-clinical testing, control on animal house, report preparation and documentation, CPCSEA guidelines. | |
| | **GOOD MANUFACUTIRNG PRACTICES** | **(09 Hours)** |
| | Good Manufacturing Practices (GMP) guidelines according to schedule M, USFDA (inclusive of CDER and CBER), pharmaceutical inspection convention (PIC), good warehousing practice. | |
| | **QUALITY CONTROL** | **(09 Hours)** |
| | Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC), in process quality control and finished products quality control. | |
| | **RECORD AND DATA MANAGEMENT** | **(10 Hours)** |
| | Documentation in pharmaceutical industry, policy, procedures and work instructions, records, standard operating procedures, master batch record, concepts of controlled and uncontrolled documents, ISO guidelines and standards. | |
| | **(Total Contact Time: 45 Hours)** | |

| 3. | **Books Recommended** |
|---|---|
| 1 | Quality Assurance of Pharmaceuticals- A compendium of Guidelines and Related materials Vol I & II, WHO Publications. |
| 2 | Good Laboratory Practice Regulations, Sandy Weinberg, Marcel Dekker. |
| 3 | How to Practice GMP's – P P Sharma, 7th Edition Vandana Publications, Delhi. |
| 4 | ICH Quality Guidelines, A Teasdale, John Wiley & Sons Inc; 1st edition, 2017. |
| 5 | ISO 9000 and total quality management, S. K. Singh, 2018. |

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| **4.** | **Additional Reading Material** |
|---|---|
| 1 | QA Manual – D.H. Shah, 1st edition, Business Horizons. |
| 2 | Good Manufacturing Practices for Pharmaceuticals a plan for total quality control – Sidney H. Willig, Vol. 52, Marcel Dekker Series. |
| 3 | Quality Systems and Controls for Pharmaceuticals, Dipak Kumar Sarkar, John Wiley & Sons |
| 4 | QA Manual – D.H. Shah, 1st edition, Business Horizons. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – III | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **FLUID FLOW OPERATIONS** | | **3** | **1** | **2** | **05** |
| **CH203** | | | | | |

| 1. | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Predict the velocity profile and flow behaviour in various types of systems. |
| CO2 | Calculate pressure loss in different types of flow systems. |
| CO3 | Calculate power requirement for fluid transport. |
| CO4 | Compare and select appropriate types of fluid moving machineries for fluid transport. |
| CO5 | Justify the use of specific fluid moving machineries. |
| CO6 | Evaluate discharge coefficient of various flow meters, select appropriate flow meters, and justify the selection of flow meters for a variety of flow conditions. |

| 2. | **Syllabus** | |
|---|---|---|
| | **INTRODUCTION** | **(03 Hours)** |
| | Definition of Unit Operations, Definition and basic concepts of fluid, Properties of fluids, Stress, Deformation, Dimensional analysis. | |
| | **FLUID STATICS AND ITS APPLICATIONS** | **(05 Hours)** |
| | Nature of fluids: Incompressible and compressible fluids, Pressure concepts, Hydrostatic equilibrium in gravitational and centrifugal field, Manometers, Inclined manometer, Continuous gravity decanter and centrifugal decanter. | |
| | **FLUID FLOW PHENOMENA** | **(05 Hours)** |
| | Types of flow, Potential flow, One dimensional flow, Laminar flow, Reynolds number, Newtonian and non-Newtonian fluids, Velocity gradient and Rate of shear, Viscosity of gases and liquids, Turbulent flow, Nature of turbulence, Eddy viscosity, Eddy diffusivity of momentum, Flow in boundary layers, Laminar and turbulent flow in boundary layers, Boundary layer formation in straight tube and flat plates, Boundary layer thickness, Boundary layer separation and wake formation. | |
| | **PROJECTION AND SECTION OF SOLIDS** | **(07 Hours)** |
| | Stream line and stream tubes, Average velocity, Mass velocity, Continuity equation, Momentum balance, Navier-Stokes equations, Bernoulli's equation. | |
| | **Flow of incompressible fluids** | **(08 Hours)** |
| | Flow of incompressible fluids in pipes, Friction factor, Laminar flow of Newtonian and non-Newtonian fluids, Turbulent flow in pipes and closed channels, Effect of roughness, Friction factor chart, Drag reduction in turbulent flow Friction factor in flow through channels of noncircular cross section, Friction from changes in velocity or direction, Effect of fittings and valves, Practical use of velocity heads in design, Minimization expansion and contraction losses. | |
| | **FLOW OF COMPRESSIBLE FLUIDS AND ITS APPLICATIONS** | **(04 Hours)** |
| | Continuity equations, Velocity of sound, Stagnation temperature, Processes of compressible flow. | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| | | |
|---|---|---|
| | **FLUID FLOW MEASUREMENTS** | **(03 Hours)** |
| | Fluid flow measurement: Venturi meter, Orifice meter, Rotameter, Pitot tubes, etc. | |
| | **FLUID MOVING MACHINERIES** | **(04 Hours)** |
| | Transportation and metering of fluids, Pipe, fitting and valves, Construction, working and characteristic features of various types of pumps, compressors, blowers and fans | |
| | **APPLICATIONS OF FLUID MECHANICS** | **(05 Hours)** |
| | Flow past immersed bodies: Drag, Drag coefficients, Flow through beds of solids, Particle motion, Terminal velocity, Hindered settling, Settling and rise of bubbles and drops, Fluidization, Introduction to computational fluid dynamics. | |
| | **Tutorial will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours + 30 Hours = 90 Hours)** | |

| **3.** | **Tutorial will be based on** |
|---|---|
| 1 | Reynolds number. |
| 2 | Flow behaviour. |
| 3 | Fluid statics. |
| 4 | Fluid flow phenomena and basic equations. |
| 5 | Flow of incompressible fluids. |
| 6 | Flow of compressible fluids. |
| 7 | Flow measurement. |
| 8 | Fluid moving machineries, etc. |
| 9 | Quiz. |
| 10 | Assignments / Mini projects & presentation on related topics. |

| 4**.** | **Practical will be based on** |
|---|---|
| 1 | Experiment on equivalent length of pipe fittings. |
| 2 | Experiment on Reynolds number. |
| 3 | Experiment on viscosity by Stokes' law. |
| 4 | Experiment on Bernoulli's theorem. |
| 5 | Experiment on venturimeter. |
| 6 | Experiment on rotameter. |
| 7 | Experiment on orifice meter. |
| 8 | Experiment on characteristics of the centrifugal pump. |
| 9 | Experiment on flow through 'V' notch. |
| 10 | Experiment on flow through rectangular notch. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| 11 | Experiment on cativation. |
| 12 | Experiment on Darcy's law. |
| 13 | Virtual Lab experiments. |

| 5. | **Books Recommended** |
|---|---|
| 1 | F. M. White, Fluid Mechanics, 9th Ed., McGraw Hill, 2022. |
| 2 | G. K. Batchelor, An Introduction to Fluid Dynamics, 2nd Ed., Cambridge Univ Press, 2000. |
| 3 | V. Gupta V., S. K. Gupta, Fluid Mechanics and Its Applications, 3rd Ed., New Age International Publ., 2015. |
| 4 | W. L. McCabe, J. C. Smith, P. Harriott P., Unit Operations of Chemical Engineering", 7th Ed., McGraw-Hill, New York, 2017. |
| 5 | R. B. Bird, W. E. Stewart, E. N. Lightfoot, Transport Phenomena, 2nd ed., John Wiley & Sons, 2006. |

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

# B. Tech.-II (Ind. Chem.) (Sem. – IV)

| Sr. No. | Subject | Code | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---|---|---|---|---|---|
| | **Fourth Semester (2nd year of B. Tech. Ind. Chem.)** | | | | |
| 1 | Heat and Mass Transfer | IC202 | 3-1-0 | 4 | 70 |
| 2 | Transition Metal Complexes and Bioinorganic Chemistry | IC204 | 3-1-2 | 5 | 100 |
| 3 | Synthetic Methodology in Organic Chemistry | IC232 | 3-0-2 | 4 | 85 |
| 4 | Machine Learning in Chemistry | IC251 | 3-0-0 | 3 | 55 |
| 5 | Innovation, Incubation and Entrepreneurship | MG110 | 3-1-0 | 4 | 70 |
| | | | **Total** | **20** | **380** |
| 6 | Vocational Training / Professional Experience (Optional) (mandatory for exit) | CYV04 / CYP04 | 0-0-10 | 5 | 200 (20 x 10) |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – IV | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **HEAT AND MASS TRANSFER**<br>**IC202** | | **3** | **1** | **0** | **03** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Explain a scope of heat and mass transfer operations in chemical industries. |
| CO2 | Explain conduction, convection and radiation principles and applications. |
| CO3 | Analyze the mechanism of mass transfer in various systems related to chemical engineering and estimate mass transfer coefficient. |
| CO4 | Determine diffusivity and flux for compounds present in gas, liquid and solid system. |
| CO5 | Analyze the mechanism of mass transfer in various systems related to chemical engineering and estimate mass transfer coefficient. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **INTRODUCTION** | **(04 Hours)** |
| | Modes of heat transfer: conduction, convection and radiation, Mechanism and applications. Introduction to Mass Transfer Operation: classification & method. | |
| | **CONDUCTION** | **(06 Hours)** |
| | General conduction equation in Cartesian coordinate, Steady state conduction through Plane, Cylindrical and Spherical walls, Steady state conduction with heat generation, Transient heat conduction and Lumped heat capacity analysis. | |
| | **CONVECTION** | **(10 Hours)** |
| | Forced and natural convection, Hydrodynamic and thermal and boundary layer, Internal and external forced convection in laminar and turbulent flow, Flow in circular and non-circular tubes, Cylinder in cross flow, Flow across banks of tubes, Convection correlations. Physical considerations, Laminar and turbulent free convection on a vertical surface, Empirical correlations, Free convection within parallel plate channels and encloser, combined free and forced convection. | |
| | **RADIATION** | **(04 Hours)** |
| | Fundamental concepts, Radiation heat fluxes, Blackbody radiation, Emission from real surfaces, Absorption, reflection, and transmission by real surfaces, Kirchhoff's law, view factor, Blackbody radiation exchange, Radiation exchange between opaque, diffuse, gray surfaces in an enclosure. | |
| | **DIFFUSION AND MASS TRANSFER** | **(10 Hours)** |
| | Molecular diffusion in fluids, Steady state diffusion (both gases & liquids), Diffusivity of liquids & gases, Diffusion in solids. | |
| | **MASS TRANFER COEFFICIENTS** | **(06 Hours)** |
| | Mass Transfer co-efficient in laminar & turbulent flow, Mass, Heat and Momentum transfer analogies. | |
| | **INTER PHASE MASS TRANSFER** | **(05 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | Equilibrium, Diffusion between phases, Material balance, Stages and efficiency. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** | |

| **3.** | **Tutorials will be based on** |
|---|---|
| 1 | Determination of stress and strain rate. |
| 2 | Detail material balance. |
| 3 | Energy balance in the system. |
| 4 | Evaluation of conduction rate of the system. |
| 5 | Determination of mass transfer rate. |
| 6 | Diffusion and flux. |
| 7 | Evaluation of convection rate of the system. |
| 8 | Determination of diffusion coefficient. |
| 9 | Psychrometric properties. |
| 10 | Evaluation of radiation rate of the system. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | Hollman, J. P., Heat Transfer – Basic Approach, 10th Edition, McGraw-Hill Pub., 2010. |
| 2 | Incropera, F.P., DeWitt, D.P., Bergman T.L., Lavine A.S., Incropera's Principles of Heat and Mass Transfer, Global Edition, Wiley India Edition, 2019. |
| 3 | Kern, D. Q., Process Heat Transfer, McGraw-Hill Int. Edition, New York, 1997. |
| 4 | Treybal R.E., "Mass-Transfer Operations", 3rd Ed., McGraw-Hill, New York, 1981. |
| 5 | Dutta, B. K., "Principles of Mass Transfer and Separation Process" PHI Learning Pvt Ltd., New Delhi, 2007. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – IV<br>TRANSITION METAL COMPLEXES AND BIOINORGANIC CHEMISTRY<br>IC204 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 1 | 2 | 05 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Learn the fundamentals of coordination compounds. |
| CO2 | Discuss basic theories on bonding in coordination compounds. |
| CO3 | Identify metal hydrides and their importance. |
| CO4 | Explain role of metal ions in biological processes. |
| CO5 | Explore the use of metal ions and complexes in medicine. |

| 2. | Syllabus | |
|---|---|---|
| | **BONDING IN TRANSITION METAL COMPLEXES** | **(20 Hours)** |
| | Crystal field theory (CFT), Crystal field splitting of d-orbitals in linear, triangular, tetrahedral, square planar, trigonal bipyramidal, square pyramidal, octahedral and pentagonal bipyramidal fields of similar and dissimilar ligands; Crystal field stabilization energy (CFSE), factors affecting the magnitude of Δ, spectrochemical series, Effect of crystal field stabilization on ionic radii, lattice energy, hydration enthalpy and stability of complexes (Irving Williams order), Jahn-Teller effect, limitations of CFT, LFT, nephelauxetic series, molecular orbital theory of coordination chemistry, Composition of ligand group orbitals, molecular orbital energy diagrams of octahedral, tetrahedral, square planar complexes including both sigma and pi bonding in complexes, Color and magnetism of Transition metal complexes. | |
| | **BIOINORGANIC CHEMISTRY** | **(20 Hours)** |
| | Biological roles of alkali and alkaline earth metal ions, ions transport (active) across biological membrane and its significance, mechanism of $Na^+/K^+$-ions pump; Metalloproteins and enzymes: role of metal ions in the active sites, structure and functions of enzymes containing Zn, Mg, Ca, Mo, Co and Cu; Carbonic anhydrase and carboxypeptidase, Zinc finger proteins; Bioinorganic chemistry of copper-electron transfer proteins, dioxygen transport and metabolism, Plastocyanin, haemocyanin, Ascorbate oxidase; nitrogen fixation, Essential and toxic metals ions in different biological processes, Porphyrins, Metalloporphyrins, haemoglobin, and myoglobin, ferritin and transferrin. Structures and functions of cytochromes, cytochrome c; iron-sulfur proteins (ferredoxines) and cytochrome c oxidase, photosynthesis: chlorophyll. | |
| | **METALS IN MEDICINE** | **(05 Hours)** |
| | Metal complexes in medicine: therapeutic applications of cis-platin, MRI (Mn and Fe) agents. Radiodiagnostic Agents. Toxicity of metals - Cd, Hg and Cr toxic effects with specific examples. Chelation therapy. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

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| | | |
|---|---|---|
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours + 30 Hours = 90 Hours)** | |

| **3.** | **Tutorials will be based on** |
|---|---|
| 1 | Problems related to splitting of d-orbitals in different complexes 1 |
| 2 | Problems related to splitting of d-orbitals in different complexes 1 |
| 3 | Calculation of CFSE of different complexes |
| 4 | Problems related to magnetism of complexes |
| 5 | Discussion of examples of the Jahn-Tellar effect. |
| 6 | Drawing of MOT diagrams of different complexes 1 |
| 7 | Drawing of MOT diagrams of different complexes 2 |
| 8 | Drawing structure of different prosthetic groups, like porphyrin, Fe-S cluster |
| 9 | Discussion of examples of metal complexes in medicine 1 |
| 10 | Discussion of examples of metal complexes in medicine 2 |

| **4.** | **Practical will be based on** |
|---|---|
| 1 | Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically) |
| 2 | Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically |
| 3 | Complexometric estimation of (i) $Mg^{2+}$ and (ii) $Zn^{2+}$ using EDTA |
| 4 | Estimation of total hardness of water samples |
| 5 | Estimation of $Al^{3+}$ by precipitating with oxime and weighing as $Al(oximate)_3$ (aluminiumoxinate) |
| 6 | Estimation of copper as CuSCN |
| 7 | Synthesis of metal complex and characterization of hexaaminecobal(III) chloride or hexaaminenickel(II) chloride |
| 8 | Synthesis of metal complex and characterization of trisoxalatoferrate(III) trihydrate) |
| 9 | Synthesis of metal complex and characterization of $[Ni(dmg)_2]$ |
| 10 | Synthesis of metal complex and characterization of $[Mn(acac)_3]$ |

| **5.** | **Books Recommended** |
|---|---|
| 1 | J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry - Principles of Structure and Reactivity, 5th Edition, Pearson Education, India, 2022. |
| 2 | J. D. Lee, Concise Inorganic Chemistry, 5th Edition, Oxford University Press, India, 2014. |
| 3 | W. Kaim, B. Schewederski, A. Klein, *Bioinorganic Chemistry -- Inorganic Elements in the Chemistry of Life: An Introduction and Guide*, 2nd Edition, John Wiley & Sons, New York, 2013. |
| 4 | B.R. Puri, L.R. Sharma, K.C. Kalia, Principles of Inorganic Chemistry, 33rd Edition, Vishal Publishing Co., India, 2022. |
| 5 | S. J. Lippard, J. M. Berg, *Principles of Bioinorganic Chemistry*, University Science Books, Mill Valley, 1994. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – IV<br>SYNTHETIC METHODOLOGY IN ORGANIC CHEMISTRY<br>IC232 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Understand the physical and chemical properties of simple and fused heterocyclic compounds. |
| CO2 | Understand the concept of pericyclic reactions. |
| CO3 | Acquire knowledge of basic concepts and various photochemical reactions. |
| CO4 | Apply the use of synthetic reagents in various organic reactions. |
| CO5 | Gain knowledge of free radical reactions. |

| 2. | Syllabus | |
|---|---|---|
| | **HETEROCYCLIC COMPOUNDS** | **(07 Hours)** |
| | Structure, preparation, properties, and reactions of furan, pyrrole, thiophene, pyridine, indole, quinoline, and isoquinoline. | |
| | **PERICYCLIC REACTIONS** | **(10 Hours)** |
| | Classification of pericyclic reactions, Electrocyclic reactions-conrotatory and disrotatory motions, 4n and 4n+2 systems, Woodward-Hoffman rules, Cycloadditions-antrafacial and suprafacial additions in 4n and 4n+2 systems. Sigmatropic rearrangements-suprafacial and antrafacial shifts of H. | |
| | **PHOTOCHEMISTRY** | **(10 Hours)** |
| | Quantum yields, techniques in photochemistry, photosensitization, and quenching mechanism. Laws of photochemistry, thermal and photochemical reactions. Photochemistry of olefins: cis-trans isomerization, dimerization reactions, Photochemistry of carbonyl compounds: Norrish type I & II reactions, Reactions of cyclic ketones, oxetane formation (Paterno-Buchi reaction). | |
| | **REAGENTS AND NAMED ORGANIC REACTIONS** | **(12 Hours)** |
| | Mechanism of action, selectivity, and utility of following reagents: Selenium dioxide, Aluminium isopropoxide, DIBAL-H, Lead tetra acetate, Sodamide, N-Bromosuccinimide, Lithium aluminium hydride, Osmium tetraoxide, Raney nickel, Sodium borohydride, Manganese dioxide, Lithium diisopropylamide (LDA), DCC, DDQ, $HIO_4$, *m*-CPBA. Appel reaction, Staudinger Reaction, Arbuzov reaction, Shapiro Reaction, Bamford-Stevens Reaction, Corey-Chaykovsky Reaction, Mitsunobu Reaction, Ugi Reaction, Woodward and Prevost hydroxylation. | |
| | **FREE RADICAL REACTIONS** | **(06 Hours)** |
| | Generation of free radicals - thermolysis, photolysis, redox methods, abstraction, addition and fragmentation; Generation of radical intermediates and its (a) addition to alkenes, alkynes (inter- and intra- molecular) for C-C bond formation, Barton deoxygenation and decarboxylation. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| 3. | Practicals will be based on |
|---|---|
| 1 | Preparation of aspirin. |
| 2 | Preparation of benzanilide from benzophenone. |
| 3 | Preparation of nitrobenzene from benzene. |
| 4 | Preparation of m-dinitrobenzene from nitrobenzene. |
| 5 | Preparation of coumarin. |
| 5 | Preparation of anthranilic acid. |
| 6 | Preparation of benzil from benzoin. |
| 7 | Preparation of benzilic acid from benzil. |
| 8 | Preparation of methyl orange. |
| 9 | Preparation of red azo dye. |
| 10 | Preparation of ibuprofen. |

| 4. | Books Recommended |
|---|---|
| 1 | N. J. Turro, V. Ramamurthy, J.C. Scaiano, Modern Molecular Photochemistry of Organic molecules, University Science Books, Sausalito, California, 2010. |
| 2 | V. K. Ahulwalia, Heterocyclic Chemistry, Narosa Publishers, 1st Edition, 2012. |
| 3 | I. Fleming, Pericylic Reactions, 2nd Edition, Oxford University Press, Oxford,2015. |
| 4 | W. Carruthers, I. Coldham, Some Modern Methods of Organic Synthesis, Cambridge University Press, Cambridge, 4th Edition, 2015. |
| 5 | F. A. Carey, R. J. Sundburg, Advance Organic Chemistry: Structure and Mechanism (Part A) (English), 5$^{th}$ Edition, Springer, 2007. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – IV | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| MACHINE LEARNING IN CHEMISTRY<br>IC251 | | 3 | 0 | 0 | 03 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Acquire knowledge of pattern recognition, regression, classification, clustering algorithms and statistics. |
| CO2 | Apply different classification, regression, machine learning algorithms and modelling. |
| CO3 | Analyze the data patterns and modelling for applying the learning algorithms. |
| CO4 | Evaluate the performance of an algorithm and comparison of different learning techniques. |
| CO5 | Design solution for real life problems like biometric recognition, natural language processing and its related applications using various tools and techniques of machine learning. |

| 2. | Syllabus | |
|---|---|---|
| | **BASIC CONCEPT** | **(15 Hours)** |
| | Pattern Representation, Concept of Pattern Recognition and Classification, Feature Extraction, Feature Selection, Basics of Probability, Bayes Decision Theory, Maximum-Likelihood and Bayesian Parameter Estimation, Error Probabilities, Learning of Patterns, Modelling, Regression, Discriminant Functions, Linear Discriminant Functions, Decision Surface, Learning Theory, Fisher Discriminant Analysis, Introduction of Artificial Intelligence (AI) and Machine learning (ML), Major component of Artificial Intelligence (AI) and Machine learning (ML), Supervised, Unsupervised and Reinforcement Learning, Deep Learning, Neural Networks, Artificial Neural Network, Data types and resources, Data management. | |
| | **SUPERVISED AND UNSUPERVISED LEARNING ALGORITHMS** | **(12 Hours)** |
| | Linear Regression, Gradient Descent, Support Vector Machines, Artificial Neural, Networks, Decision Trees, ML and MAP Estimates, K-Nearest Neighbor, Naive Bayes, Bayesian Networks, Classification, Overfitting, Regularization, Multilayer Networks, Back-propagation, Bayes Classification, Nearest Neighbor Classification, Cross Validation and Attribute Selection, K Means Clustering, K-Means Clustering, Gaussian Mixture Models, Learning with Partially Observable Data, Expectation Maximization Approach. Dimensionality Reduction, Principle Component Analysis, Model Selection and Feature Selection. | |
| | **ML APPLICATIONS IN CHEMISTRY AND PHARMACEUTICALS** | **(10 Hours)** |
| | ML application in Protein Folding, Catalysis, Reaction Kinetics, Material Design, Energy and Structure Prediction, Simulation and Enhanced Sampling, Current implementation and application of Artificial Intelligence and Machine Learning in Pharmaceuticals, Artificial Intelligence and Machine Learning derived drug discovery Good machine learning practice (GMLP); Tools in AI and ML-driven drug discovery (de novo and repurposing approach). | |
| | **CHALLENGES, OPPORTUNITIES AND ETHICS** | **(08 Hours)** |
| | Benefits and Opportunities of AI/ML in the Pharmaceutical Industry, Real-world performance (RWP) monitoring for AI/ML software, Digital Unfamiliar technology, Future with Covid-19 digital Opportunities and challenges, Technical and Logistical challenges, Modern Regulatory challenges | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| | in drug discovery, clinical trial, Product registration, Ethical consideration and Cyber security, Ethical guidelines and responsible AI/ML practices, AI/ML and Innovation, Emerging trends and future directions in AI/ML, AI/ML and creativity: Generative models and artistic applications. |
| | **(Total Contact Time: 45 Hours)** |

| **3.** | **Books Recommended** |
|---|---|
| 1 | H. M. Cartwright, Machine Learning in Chemistry: The Impact of Artificial Intelligence, Royal Society of Chemistry, 2020. |
| 2 | D. C Spellmeyer, D. Sahner, Artificial Intelligence: Emerging Applications in Biotechnology and Pharma Biotechnology Entrepreneurship, 399-417, 2020. |
| 3 | C. M. Bishop, Pattern Recognition and Machine Learning, 1st Edition, Springer, 2006. |
| 4 | A. Philip, A. Shahiwala, M. Rashid, & M. Faiyazuddin, A Handbook of Artificial Intelligence in Drug Delivery. Academic Press, An Imprint of Elsevier, 2023. |
| 5 | K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Edition, Academic Press, 2000. |

| **4.** | **Additional Reading Material** |
|---|---|
| 1 | G. Dougherty, Pattern Recognition and Classification: An Introduction, 1st Edition, Springer,2013. |
| 2 | Theodoridis, K. Koutroumbas, Recognition, 4th Ed., Academic Press, 2009. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – II (Ind. Chem.), Semester – IV | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **INNOVATION, INCUBATION AND ENTREPRENEURSHIP**<br>**MG110** | | **3** | **1** | **0** | **04** |

| 1. | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Explain the concepts of Entrepreneurship. |
| CO2 | Develop skills related to various functional areas of management (Marketing Management, Financial Management, Operations Management, Personnel Management etc.) |
| CO3 | Develop skills related to Project Planning and Business Plan development. |
| CO4 | Demonstrate the concept of Innovation, Intellectual Property Rights (IPR) and Technology Business incubation. |
| CO5 | Build knowledge about Sources of Information and Support for Entrepreneurship. |

| 2. | **Syllabus** | |
|---|---|---|
| | **CONCEPTS OF ENTREPRENEURSHIP** | **(8 Hours)** |
| | Scope of Entrepreneurship, Definitions of Entrepreneurship and Entrepreneur, Entrepreneurial Traits, Characteristics and Skills, Entrepreneurial Development models and Theories, Entrepreneurs Vs Managers, Classification of Entrepreneurs; Major types of Entrepreneurship – Techno Entrepreneurship, Women Entrepreneurship, Social Entrepreneurship, Intrapreneurship (Corporate entrepreneurship), Rural Entrepreneurship, Family Business etc.; Problems for Small Scale Enterprises and Industrial Sickness; Entrepreneurial Environment – Political, Legal, Technological, Natural, Economic, Socio – Cultural etc. | |
| | **FUNCTIONAL MANAGEMENT AREA IN ENTREPRENEURSHIP** | **(16 Hours)** |
| | Marketing Management: Basic concepts of Marketing, Development of Marketing Strategy and Marketing plan, Operations Management: Basic concepts of Operations management, Location problem, Development of Operations strategy and plan, Personnel Management: Main operative functions of a Personnel Manager, Development of H R strategy and plan, Financial Management: Basics of Financial Management, Ratio Analysis, Investment Decisions, Capital Budgeting and Risk Analysis, Cash Flow Statement, Break Even Analysis. | |
| | **PROJECT PLANNING** | **(8 Hours)** |
| | Search for Business Idea, Product Innovations, New Product Development – Stages in Product Development; Sequential stages of Project Formulation; Feasibility analysis – Technical, Market, Economic, Financial etc.; Project report; Project appraisal; Setting up an Industrial unit – procedure and formalities in setting up an Industrial unit; Business Plan Development. | |
| | **PROTECTION OF INNOVATION THROUGH IPR** | **(3 Hours)** |
| | Introduction to Intellectual Property Rights – IPR, Patents, Trademarks, Copy Rights. | |
| | **INNOVATION AND INCUBATION** | **(6 Hours)** |
| | Innovation and Entrepreneurship, Creativity, Green Technology Innovations, Grassroots Innovations, Issues and Challenges in Commercialization of Technology Innovations, Introduction to Technology | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | Business Incubations, Process of Technology Business Incubation. | |
| | **SOURCES OF INFORMATION AND SUPPORT FOR ENTREPRENEURSHIP** | **(4 Hours)** |
| | State level Institutions, Central Level institutions and other agencies. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** | |

| **3.** | **Tutorials will be based on** |
|---|---|
| 1 | Case Study Discussion 1. |
| 2 | Case Study Discussion 2 |
| 3 | Case Study Discussion 3. |
| 4 | Group Discussion 1. |
| 5 | Group Discussion 2. |
| 6 | Group Discussion 3. |
| 7 | Management Game 1. |
| 8 | Management Game 2. |
| 9 | Assignments 1. |
| 10 | Assignments 2. |
| 11 | Presentation on Related Topic 1. |
| 12 | Presentation on Related Topic 2. |
| 13 | Presentation on Related Topic 3. |
| 14 | Presentation on Related Topic 4. |
| 15 | Mini Project. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | V. Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, India, 6th Revised Edition, 2020. |
| 2 | P. M. Charantimath, Entrepreneurial Development and Small Business Enterprises, Pearson Education, 3rd Edition, 2018. |
| 3 | D. H. Holt, Entrepreneurship: New Venture Creation, Pearson Education, 2016. |
| 4 | P. Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation and Review, Tata McGraw Hill, 9th Edition, 2019. |
| 5 | T. R. Banga, S. C. Sharma, Industrial Organisation & Engineering Economics, Khanna Publishers, 25th Edition, 2015. |

| **5.** | **Additional Reading Material** |
|---|---|
| 1 | L.M. Prasad, Principles & Practice of Management, Sultan Chand & Sons, 8th Edition,2015. |
| 2 | E. A. Everett, R. J. Ebert, Production and Operations Management, Prentice Hall of India, 5th edition, 2012. |
| 3 | P. Kotler, K. L. Keller, A. Koshi, M. Jha., Marketing Management – A South Asian Perspective, Pearson, 14th Edition, 2014. |
| 4 | P. C. Tripathi, Personnel Management & Industrial Relations, Sultan Chand & sons, 21st Edition, 2013. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| 5 | P. Chandra, Financial Management, Tata McGraw Hill, 9th Edition, 2015. |

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

# B. Tech.-III (Ind. Chem.) (Sem. – V)

| Sr. No. | Subject | Code | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---|---|---|---|---|---|
| | **Fifth Semester (3rd year of B. Tech. Ind. Chem.)** | | | | |
| 1 | Catalysis in Industries | IC301 | 3-1-0 | 4 | 70 |
| 2 | Unit Processes in Chemical Industries | IC303 | 3-0-2 | 4 | 85 |
| 3 | Pharmaceutical Chemistry | IC331 | 3-0-2 | 4 | 85 |
| 4 | Elective | IC3XX/ CH3XX | 3-0-0 | 3 | 55 |
| 5 | Institute Elective | CY361 | 3-0-0 | 3 | 55 |
| 6 | Seminar | IC305 | 0-0-2 | 1 | 40 |
| 7 | MOOC Course* | ϕ | | | |
| | | | **Total** | **19** | **390** |
| 8 | Vocational Training / Professional Experience (Optional) (mandatory for exit) | CYV05 / CYP05 | 0-0-10 | 5 | 200 (20 x 10) |

* MOOC Course may be registered in the Fifth or Sixth Semester

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – V | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **CATALYSIS IN INDUSTRIES**<br>**IC301** | | **3** | **1** | **0** | **04** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to:** |
|---|---|
| CO1 | Understand basics and principle of catalysis and their potential to be used for range of applications. |
| CO2 | Acquire knowledge on catalyst preparation methods. |
| CO3 | Understand and correlate properties and end use applications of catalysts and learn how this insight can be used to design catalysts for intended industrial applications . |
| CO4 | Acquire knowledge on design of green industrial chemical processes. |
| CO5 | Compile and propose new applications of catalysis in multidisciplinary areas. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **INTRODUCTION TO CATALYSIS CONCEPTS** | **(08 Hours)** |
| | Green chemistry and catalysis, activation energy, activity, surface acidity and its determination, specificity selectivity, promoter, concept of TON and TOF, catalyst deactivation, homogeneous catalysis, heterogeneous catalysis, shape selective catalysis, homogenized heterogeneous catalysis, environmental catalysis, phase transfer catalysis and bio-catalysis. | |
| | **CATALYST TYPES** | **(06 Hours)** |
| | Metal Solid acid catalysts, solid base catalysts, metal-based catalysts, metal oxides, metal nanoparticles as catalysts, bimetallic catalysts, photocatalysts and supported catalysts. | |
| | **CATALYST PREPARATION METHODS** | **(07 Hours)** |
| | Precipitation, impregnation, sol-gel, dry-gel, template method, hydrothermal method, vapour phase method, microwave method, solid state crystallization method, ion exchange and catalyst preparation by functionalization, and an overview of commercial manufacturing of catalysts. | |
| | **INDUSTRIAL APPLICATIONS OF CATALYSIS** | **(12 Hours)** |
| | For petroleum industry, polymer industry, pharmaceutical & speciality chemical industry, battery industries, fertilizer industry, textile industry and food industry. | |
| | **CATALYSIS FOR BIOENERGY PRODUCTION AND ENVIRONMENTAL APPLICATIONS** | **(12 Hours)** |
| | For renewable and low-carbon fuels [for e. g. renewable diesel, SAF (Sustainable Aviation Fuel, eMethanol, low-carbon hydrogen and green ammonia], harmful gas emission control, biomass conversion to bioenergy production and plastic waste conversion to value added products. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** | |

| **3.** | **Tutorials will be based on** |
|---|---|
| 1 | atom economy. |
| 2 | *E*-factor of the process. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| 3 | calculation of activation energy: methods and examples. |
| 4 | calculation of selectivity in catalysis. |
| 5 | calculation of enantioselectivity in catalysis. |
| 6 | concept of TON and TOF. |
| 7 | type of metal catalysts. |
| 8 | type of metal oxides and metal nanoparticles. |
| 9 | type of solid acid catalysts. |
| 10 | catalyst preparation methods. |
| 11 | type of ion exchange. |
| 12 | type of separation processes in petroleum industry. |
| 13 | type of pharmaceutical chemical industry. |
| 14 | type of metal in battery industries. |
| 15 | type of harmful gas emission control. |

| **3.** | **Books Recommended** |
|---|---|
| 1 | Housecroft C.E. Sharpe A.G., Inorganic Chemistry, 5th Edition, Pearson Education Ltd. UK, 2018. |
| 2 | B. Vishwanathan, S. Sivasanker, A. V. Ramaswamy, Catalysis: Principles and Applications, 3rd Edition, Narosa Publishing House Pvt. Ltd., India, 2009. |
| 3 | J. Cejka, A. Corma, S. Zones, Zeolites and Catalysis Synthesis, Reactions and Applications, 1st Edition, Wiley-VCH Verlag GmbH &Co. KGaA, Weinheim, 2009. |
| 4 | J. Hagen, Industrial Catalysis: A Practical Approach, 3rd Edition, 2015 Wiley-VCH Verlag GmbH & Co. KGaA, Germany, 2015. |
| 5 | G. Rothenberg, Catalysis: Concepts and Green Applications, 2nd Edition, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2008. |

| **4.** | **Additional Reading Material** |
|---|---|
| 1 | Maitlis, P. M., Klerk A. de, Greener Fischer-Tropsch Processes for Fuels and Feedstocks, 1st Edition, Wiley-VCH, Weinheim, Germany, 2013. |
| 2 | G. C. Bond, Catalysis by Metals, 2nd Edition, Academic Press: London, 1962. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – V | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| UNIT PROCESSES IN CHEMICAL INDUSTRIES<br>IC303 | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Develop an introductory knowledge of chemical industry and unit processes. |
| CO2 | Build a bridge between theoretical and practical concept used in industry. |
| CO3 | Explore the various synthetic methods of producing industrial chemicals and their applications. |
| CO4 | Appraise knowledge about the basic chemistry of production. |
| CO5 | State the industrial chemical process of transforming raw materials to desired products. |

| 2. | Syllabus | |
|---|---|---|
| | **NITRATION** | **(06 Hours)** |
| | Introduction, Nitrating Agents, Aromatic Nitration, Process Equipment for Technical Nitration, Batch Nitration, Continuous Nitration, manufacturing of nitrobenzene by batch and continuous process using fortified spent acid, m-dinitrobenzene and p-nitro acetanilide. | |
| | **AMINATION BY REDUCTION & AMMONOLYSIS AND HALOGENATION** | **(08 Hours)** |
| | Amination: Introduction, Different types of reduction reactions, Schimdt and Biazzi nitrators, different reduced products of nitrobenzene, manufacturing of aniline by Bechamp reduction, m-nitro aniline and aniline by ammonolysis.<br>Halogenation: Introduction, different halogenating agents and halogenation reactions, mechanism and manufacturing of BHC and chlorobenzene. | |
| | **SULFONATION & SULFATION** | **(05 Hours)** |
| | Introduction, Sulfonating & Sulfating agents, Sulfonation of Aromatic Compounds. Chemical and physical factors in sulfonation and sulfation, Commercial manufacturing of benzene sulfonic acid (Barbet process) and naphthalene sulfonic acid. | |
| | **OXIDATION** | **(06 Hours)** |
| | Introduction, Types of oxidizing agents and reactions, Oxidation of toluene with $MnO_2$. Manufacture of acetaldehyde from acetic acid and acetic acid from ethanol. Commercial manufacturing of benzoic acid and phthalic anhydride. | |
| | **HYDROGENATION AND ALKYLATION** | **(10 Hours)** |
| | Hydrogenation: Introduction and scope, properties and sources of hydrogen, gas catalytic hydrogenation and hydrogenolysis, factors affecting hydrogenation, industrial hydrogenation of fat and oil, manufacture methanol from $CO_2$ and $H_2$.<br>Alkylation: Introduction, Types of alkylation, alkylating agents, factors controlling alkylation, equipment for alkylation, manufacture of alkyl aryl sulphonates and ethylbenzene by continuous process. | |
| | **ESTERIFICATION AND HYDROLYSIS** | **(10 Hours)** |
| | Esterification: Introduction, Esterification of organic acids. Commercial manufacture of some | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | important compounds.<br>Hydrolysis: Introduction, Hydrolysing agents, Equipment for hydrolysis, industrial hydrolysis of fat, manufacture of ethanol from ethylene (Shell process) and phenol from benzene sulfonic acid. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| **4.** | **Practical will be based on** |
|---|---|
| 1 | Estimation of Nitrogen in the given sample fertilizer sample. |
| 2 | Determination of amount of Nitrogen in the given sample by Kjeldahl's method. |
| 3 | Preparation of M-dinitrotoluene. |
| 4 | Preparation of p-nitrocetanilide. |
| 5 | Preparation of p-aminoacetanilide. |
| 6 | Preparation of sulphanilic acid. |
| 7 | Preparation of m-toluenediamine. |
| 8 | Halogenation of acetone. |
| 9 | Estimation of the Amines in an organic compound using bromate-bromide solution method. |
| 10 | Preparation of p-chlorotoluene from p-toluene. |

| **5.** | **Books Recommended** |
|---|---|
| 1 | M. Gopala Rao, M. Sittig, Dryden's Outlines of Chemical Technology, 3rd Edition, East-West Press, 2010. |
| 2 | G. T. Austin, Shreve's Chemical Process Industries, 5th Edition, McGraw-Hill Pub., New York, 2017. |
| 3 | R. M. Felder, R. W. Rousseau, L. G. Bullard Elementary Principles of Chemical Processes, 4$^{th}$ Edition, John Wiley, New York, 2016. |
| 4. | J. A. Kent (Ed.) Riegel's Handbook of Industrial Chemistry, 10th Edition, Kluwer Academic Publishers, New York, 2003. |
| 5. | P. H. Groggins, Unit Processing of Organic Synthesis, 5th Edition, Tata-McGraw Hill, New Delhi, 2001. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – V | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **PHARMACEUTICAL CHEMISTRY** | | **3** | **0** | **2** | **04** |
| **IC331** | | | | | |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Explain methodology followed in drug design and various theories of drug activity. |
| CO2 | Evaluate the mechanism of action and clinical implications of general anaesthetics. |
| CO3 | Learn concepts of drug disposition and elimination. |
| CO4 | Learn the mechanism pathways of different class of medicinal compounds. |
| CO5 | Apply knowledge to drug development and clinical applications. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **DRUG DISCOVERY AND DEVELOPMENT** | **(05 Hours)** |
| | Drug Discovery: Stages of drug discovery: Disease identification, target identification and validation, lead discovery and optimization, preclinical and clinical trials. | |
| | **ROUTES OF DRUG ADMINISTRATION AND PHARMACOKINETICS** | **(08 Hours)** |
| | Systemic Route: Enteral route: Oral, Parenteral route: Intravascular, Intramuscular, Subcutaneous, Inhalation; Local Route: Mucosal membranes, skin. Classification of drugs, Pharmacokinetics: Drug adsorption, Distribution and disposition of drugs, excretion and elimination. Lipinski's Rule of Five. | |
| | **PHARMACODYNAMICS** | **(08 Hours)** |
| | pharmacodynamics in drug development process, Enzyme stimulation, enzyme inhibition, membrane active drugs, drug metabolism, toxicology, dose and dose response, toxicity of metabolism. | |
| | **GENERAL ANAESTHETICS** | **(08 Hours)** |
| | General anaesthetics: classification: inhalation anaesthetics, intravenous anaesthetics, basal anaesthetics mode of action of general anaesthetics: lipid theory, physical theory, biochemical theory, miscellaneous theory, Meyer-Overton theory, minimum alveolar concentration (mac) stereochemical effects. ion channel and protein receptor hypotheses, mechanism of action general anaesthetic. | |
| | **ANTIPYRETIC ANALGESICS** | **(08 Hours)** |
| | Classification, aniline and p-aminophenol analogues, salicylic acid analogues, quinoline derivatives, pyrazolones and pyrazolodiones, the N-arylanthranilic acids, mechanism of action, mechanism of action of selected antipyretic-analgesics. Narcotic Analgesics (opiate analgesics): Limitations, characteristics, classification and mechanism of action of certain narcotic analgesics. | |
| | **SYNTHESIS OF SELECTIVE DRUGS** | **(08 Hours)** |
| | Sulfa drugs, Ciprofloxacin, Ibuprofen, Atenolol, Captopril, Diazepam, Chloroquine, Sulphanilamide, Miconazole, Biotin, Ethambutol, Ranitidine, and Omeprazole. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

| | |
|---|---|
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** |

| **3.** | **Practical will be based on** |
|---|---|
| 1 | Synthesis of nitro-glycerine from glycerol. |
| 2. | Synthesis of barbital from diethyl 2,2-diethyl malonate. |
| 3. | Synthesis of phenytoin from benzil. |
| 4. | Synthesis of sulfamethoxazole from p-acetamedo benzene sulfonyl chloride. |
| 5. | Synthesis of benzocaine from p-amino benzoic acid. |
| 6. | Synthesis of methyl salicylate from salicylic acid. |
| 7. | Synthesis of p-iodo benzoic acid from *p*-benzoic acid. |
| 8. | Estimation of isoniazide (Volumetric). |
| 9. | Estimation of penicillin (Volumetric). |
| 10. | Estimation of sulpha drug (Volumetric). |

| **4.** | **Books Recommended** |
|---|---|
| 1 | M.E. Wolf, ed, The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry John Wiley and Sons, 8th Edition, New York 2021. |
| 2 | A. Kar, *Medicinal Chemistry,* New age international Publisher, 4th Edition, India 2007. |
| 3 | J.M. Beale, J.H. Block, Wilson and Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry, Lippincott Williams & Wilkins, 12th Edition, New York 2011. |
| 4 | T. L. Lemke, D. A. Williams, V. F. Roche, S. W. Zito, Foye's Principles of Medicinal Chemistry, Lippincott, Williams Wilkins, 7th Edition, Baltimore 2013. |
| 5 | G.L. Patrick, *An Introduction to Medicinal Chemistry*, Oxford University Press, 7th Edition, Oxford 2023. |

| **5.** | **Additional Reference Books** |
|---|---|
| 1 | A. Korolkovas, Essentials of Medicinal Chemistry, Wiley Interscience, 2nd Edition, New York, 2008. |
| 2 | R. B. Silverman, The Organic Chemistry of Drug Design and Drug Action, Academic Press New York 3rd Edition, 2014. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

# B. Tech.-III (Ind. Chem.) (Sem. – VI)

| Sr. No. | Subject | Code | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---|---|---|---|---|---|
| | **Sixth Semester (3rd year of B. Tech. Ind. Chem.)** | | | | |
| 1 | Polymer Science and Technology | IC302 | 3-0-2 | 4 | 85 |
| 2 | Chemistry in Industries | CY308 | 3-0-0 | 3 | 55 |
| 3 | Instrumentation and Process Control | CH302 | 3-1-2 | 5 | 100 |
| 4 | Elective | IC3XX/ CH3XX | 3-1-0/ 3-0-2 | 4 | 70/ 85 |
| 5 | Institute Elective | CY353 | 3-0-0 | 3 | 55 |
| 6 | Project-I | IC306 | 0-0-6 | 3 | 90 |
| 7 | MOOC Course* | ϕ | | | |
| | * MOOC Course may be registered in the Fifth or Sixth Semester | | **Total** | **22** | **455/470** |
| 8 | Vocational Training / Professional Experience (Optional) (mandatory for exit) | CYV06 /CYP06 | 0-0-10 | 5 | 200 (20 x 10) |

* MOOC Course may be registered in the Fifth or Sixth Semester

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – VI | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **POLYMER SCIENCE AND TECHNOLOGY**<br>**IC302** | | **3** | **0** | **2** | **04** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Memorize the basic concept of polymers. |
| CO2 | Categorize newer techniques in polymer synthesis. |
| CO3 | Examine the rheological behaviour in polymers. |
| CO4 | Interpret various characterization techniques in polymers. |
| CO5 | Design speciality polymers with its waste management. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **FUNDAMENTALS OF POLYMER SCIENCE** | **(09 Hours)** |
| | Historical background, basic concept and classification, importance of polymers, Polymer structure and properties.<br>Basic aspects of polymer synthesis techniques: mass, solution, suspension, emulsion and gas phase polymerization.<br>Mechanism and kinetics of Radical/ chain polymerization, Mode of termination - chain transfer to monomer, initiator, chain transfer agent, Inhibition & retardation.<br>Living and non-living chain polymerization, co-ordination polymerization, co-polymerization, ionic polymerization, ring opening polymerization.<br>Newer Techniques in Polymerization: Metathesis polymerization, Controlled polymerization methods, viz, Nitroxide mediated polymerization (NMD), Atom Transfer Radical Polymerization (ATRP), Group Transfer Polymerization (GTP), Reversible Addition Fragmentation Termination (RAFT). | |
| | **POLYMER ADDITIVES** | **(05 Hours)** |
| | Lubricants, Plasticizers, Fillers and reinforcements, Stabilizers, Anti-ageing additives, Ultra violet protective agents, Optical property modifiers: Brightening agents, Inorganic and Organic pigments. | |
| | **POLYMER RHEOLOGY AND MORPHOLOGY** | **(07 Hours)** |
| | Polymer conformation and configuration, Polymer melts and polymer solutions, dilute solution properties, viscosity, shear and extensional viscosities, Dependence of shear viscosity on temperature, pressure, molecular weight, flow curve linear viscoelasticity.<br>Newtonian, non-Newtonian, continuous theories and related models, non-Newtonian liquid flow through cylindrical pipes.<br>Cooling of polymers from melts and solution. Crystallization, single crystal and spherulites, phase separation. Morphology of multiphase polymer systems, amorphous and crystalline state. | |
| | **POLYMER CHARACTERIZATION** | **(10 Hours)** |
| | Determination of molecular weight by Ultra Centrifugation, Gel Permeation Chromatography. End Group Analysis, Ebulliometry, Cryoscopy, Osmometry, and viscometry. | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | Material Characterization Test: Introduction, melting point, softening point, Thermal conductivity, Shrinkage, Melt Flow Index test, Particle size, Density, and bulk factor, Water and Moisture absorption.<br>Mechanical and Flammability, Electrical, Chemical and Weathering Properties.<br>Instrumental Polymer Analysis: Thermogravimetric Analysis (TGA), Differential Scanning Calorimetry, Thermomechanical Analysis, Dynamic Mechanical Analyses, Scanning Electron Microscopy (SEM), and Transmission Electron Microscopy (TEM). | |
| | **SPECIALITY POLYMERS** | **(09 Hours)** |
| | Reasons for high performance in polymers, structural characteristics, their properties: thermal, electrical, optical, electronic. Durability in harsh and low earth orbit (space) environments.<br>Temperature resistance polymers, Conducting Polymers, Polymers in non-linear optics, Polymers with piezo, pyro, ferro electric characters, Ionic Polymers, Hydrophilic Polymers, Liquid crystalline polymers, Thermoplastics Polymers and Thermosetting Polymers. | |
| | **POLYMER WASTE MANAGEMENT** | **(05 Hours)** |
| | Introduction to ecology and environment. Importance of polymer waste management. Degradation of polymers. Types of polymer waste, municipal solid waste (MSW).<br>Introduction - sources of plastics waste, separation techniques - density based sorting, optical sorting, spectroscopic sorting, electrostatic sorting, sorting by size reduction, melting temperature, selective dissolution.<br>Plastics Waste Management – reduction, reuse, repair, recycling, recycling classification, code of practice-primary, secondary, tertiary, quaternary recycling with examples.<br>Disposal by land filling, energy recovery, environmental impacts of waste management disposal methods. Life cycle assessment, risk factor analysis. Limitation of current technology, role of industry, consumers.<br>Government and NGOs, sustainable development and waste management. Green approaches, principles of green chemistry- prevention of waste, atom economy, triple bottom line approach, green polymers and green technology. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| 3. | **Practical will be based on** |
|---|---|
| 1 | Synthesis of glyptal resin. |
| 2 | Phenol formaldehyde resin from phenol. (Novalac and Resol). |
| 3 | Urea formaldehyde resin from urea. |
| 4 | Melamine formaldehyde resin from urea. |
| 5 | Determination of the saponification value of given oil. |
| 6 | Determination of the hydroxyl value and acid value of the given resin. |
| 7 | Preparation of acrylonitrile polymer by solution polymerization. |
| 8 | Determination of molecular weight of polymer. |
| 9 | Preparation of polyurethane prepolymer. |
| 10 | FT-IR and thermogravimetric (TG) analyses of polymer. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

| **4.** | **Books Recommended** |
|---|---|
| 1 | C. S. Brazel, S. L. Rosen, Fundamental Principles of Polymeric Materials, 3rd Edition, John Wiley & Sons, 2012. |
| 2 | V. R. Gowariker, N.V. Viswanathan, J. Sreedhar, Polymer Science, New Age International, 2010. |
| 3 | Y. G. Yanovsky, Polymer Rheology: Theory and Practice, Chapman & Hall, London, 2007. |
| 4 | P. Bahadur, N. V. Sastry, Principles of Polymer Science, Narosa Publishing House, New Delhi, 2002. |
| 5 | P. Ghosh, Polymer Science and Technology: Plastics, Rubber, Blends and Composites, McGraw Hill Education, 2017. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – VI<br>CHEMISTRY IN INDUSTRIES<br>CY308 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 03 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Explain process technologies of various organic and inorganic process industries. |
| CO2 | Discuss the process flow diagram and various process parameters. |
| CO3 | Explore various synthetic methods of producing industrial chemicals, their applications. |
| CO4 | Memories the basic chemistry of production. |
| CO5 | Acquire knowledge about laboratory and plant safety and management. |

| 2. | Syllabus | |
|---|---|---|
| | **NITROGEN INDUSTRY** | **(07 Hours)** |
| | Introduction, manufacture of synthetic nitrogen products and miscellaneous chemicals such as ammonia, hydro amine, fluorocarbon and various types of nitrogenous fertilizers such as urea, ammonium sulphate, ammonium nitrate, calcium ammonium nitrate. | |
| | **FERMENTATION INDUSTRY** | **(06 Hours)** |
| | Introduction, culture development, inoculum preparation, nutrients for microorganisms, toxic effects on culture, manufacture of industrial alcohol, absolute alcohol, vinegar, downstream processing. | |
| | **PERFUMERY INDUSTRY** | **(06 Hours)** |
| | Compounds used for different perfumes, vehicles, fixatives, odorous substances, preparation of phenyl ethanol, synthesis of musk ketone, musk xylene, vanillin, perfume formulation. | |
| | **AGROCHEMICAL AND PESTICIDE INDUSTRY** | **(06 Hours)** |
| | Classification of agrochemicals, classification of insecticide, ammonium phosphate, super phosphate, BHC, Uses of agrochemicals and environments. | |
| | **INDUSTRIAL GASES** | **(06 Hours)** |
| | Industrial Gases – Manufacture of hydrogen, oxygen, nitrogen, carbon dioxide, chlorine and sulphur dioxide. | |
| | **LABORATORY SAFETY AND PROCESS SAFETY** | **(06 Hours)** |
| | Personal protective equipment, nature of the hazard and the task, compatibility with other PPE, chemicals being used, including concentration and quantity, hazards posed by the chemicals, routes of exposure for the chemicals, material the PPE is constructed of, safety signs, hazard assessment. | |
| | **INDUSTRIAL SAFETY AND HAZARDS** | **(08 Hours)** |
| | Industrial hazards and safety considerations in chemical industries, mechanical, electrical and chemical hazards, fire and explosion hazards, health hazards, laboratory safety, control of plant hazards, safety practice. | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| | |
|---|---|
| | **(Total Contact Time: 45 Hours)** |

| **3.** | **Books Recommended** |
|---|---|
| 1 | G. T. Austin, Shreve's Chemical Process Industries, 5th Edition, Tata McGraw Hill, 2017. |
| 2 | Engineering Chemistry, Jain and Jain (Dhanpat Rai and Sons). |
| 3 | B. K. Sharma, Industrial Chemistry, 3rd Edition, Krishna Prakashan Media (P) Ltd., Meerut, 2001. |
| 4 | M. Ash, I. Ash, Formulary of Cosmetic Preparations, 1st Edition, Chemical Publishing, 1977. |
| 5 | F. V. Wells, M. Billot, Perfumery Technology, 2nd Edition, Longman Higher Education, 1981. |

| **4.** | **Additional Reading Material** |
|---|---|
| 1 | J. A. Kent, Riegel's Hand Book of Industrial Chemistry, 6th Edition, CBS Publishers & Distributors, New Delhi, 1986. |
| 2 | M. L. Srivastava, Fermentation Technology, Narosa Publisher, 2008. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. III (Ind. Chem.), Semester - VI | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **INSTRUMENTATION AND PROCESS CONTROL**<br>**CH302** | | **3** | **1** | **2** | **05** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course the students will be able to:** |
|---|---|
| CO1 | Understand the differential equation models of first and second order system |
| CO2 | Analyse first order system and higher order system for various real systems and apply the concepts in practical knowledge |
| CO3 | Apply and estimate dynamic behaviour for various disturbances |
| CO4 | Recognize closed loop transfer functions and various controllers and stability of control system |
| CO5 | Evaluate frequency response to systems and Design control system by controller tuning methods to industrial control systems |
| CO6 | Recognize advanced controllers and their requirement and apply the concepts for practical knowledge in industries |

| **2.** | **Syllabus** | |
|---|---|---|
| | **INTRODUCTION** | **(01 Hours)** |
| | Steady and unsteady state design equation for an agitated heated tank. Introduction to P, PI, and PID controls. | |
| | **DYNAMICS OF FIRST ORDER SYSTEMS** | **(05 Hours)** |
| | Dynamics of first order systems subjected to various disturbances like step, ramp, impulse & sinusoidal e.g. liquid level tanks, mixing process, thermometer etc. response of first order system in series. | |
| | **DYNAMICS OF SECOND ORDER SYSTEMS** | **(06 Hours)** |
| | Dynamics of second order systems subjected to various disturbances like step, impulse, sinusoidal. | |
| | **LINEAR CLOSE LOOP SYSTEM** | **(03 Hours)** |
| | Linear close loop system, Servo and Regulator problem. | |
| | **CLOSED LOOP TRANSFER FUNCTION** | **(04 Hours)** |
| | Closed loop transfer function, block diagrams for various simple systems, Transient response of the control system. | |
| | **STABILITY OF CONTROL SYSTEM** | **(05 Hours)** |
| | Stability of control system, Routh test criterion, Concept of Root Locus, frequency analysis, Bode diagrams for simple order system (first order system, second order system, P, PI, PD controllers) | |
| | **ADVANCED CONTROL and USE OF MATLAB IN PROCESS CONTROL** | **(07 Hours)** |
| | Cascade Control, Feed forward Control, Ratio control, Split Range Control, Auctioneering Control | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | and Multivariable Control. | |
| | **CONTROLLER TUNING AND PROCESS IDENTIFICATION, CONTROLLERS AND CONTROL ELEMENTS** | **(06 Hours)** |
| | Controller, control elements, control valves. | |
| | **DISTRIBUTED CONTROL SYSTEM (DCS)** | **(02 Hours)** |
| | Distributed control system (DCS), Programmable Logical Control System (PLC). | |
| | **FLOW, LEVEL, PRESSURE AND TEMPERATURE MESUREMENT** | **(02 Hours)** |
| | Construction, working principle, selection criteria and application of the measurement devices | |
| | **SENSOR AND TRANSDUCER, INSTRUCTION PANELS, INTERFACE** | **(02 Hours)** |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours+30 Hours = 90 Hours)** | |

| **3.** | **Tutorials** |
|---|---|
| 1 | Derivations/Numericals based on first order systems |
| 2 | Numericals/Derivations based on second order systems |
| 3 | Numericals/Derivations based on Closed Loop Transfer Function |
| 4 | Stability of control system, Routh test criterion, Concept of Root Locus, |
| 5 | Frequency analysis |
| 6 | Bode diagrams for simple order system (first order system, second order system, P, PI, PD controllers) |
| 7 | Z-N TUNING |

| **4.** | **Practical** |
|---|---|
| 1 | Dynamics of First Order Liquid Level System. |
| 2 | Study of Linearization |
| 3 | Dynamics of Non Interacting Tanks. |
| 4 | Dynamics of Interacting Tanks |
| 5 | Response of Manometer system |
| 6 | P-PI Controller |
| 7 | Cascade and Split Range Controller, Ratio and Feed Back - Feed Forward Controller |
| 8 | Dynamic Simulation of Distillation Operation |
| 9 | Control of CSTR in Series , Control of PFR, Control of EVAPORATOR |
| 10 | Study of Temperature Control Trainer, Pressure Control Trainer, Flow Control Trainer, Level Control Trainer |
| 11 | Dissolved Oxygen Meter, Thermocouple Calibration |

| **5.** | **Books Recommended** |
|---|---|

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| 1 | Coughnowr D.R., Steven E. LeBlanc "Process Systems Analysis and Control", 3rd Edition, McGraw Hill Inc., New York, 2009. |
| 2 | Stephanopoulos G.," Chemical Process Control", Prentice Hall of India Private Ltd., New Delhi, 2001. |
| 3 | Luben W.L. & Luben M.L., "Essentials of Process Control", McGraw Hill Inc., New York, 1997. |
| 4 | Kopell L.B. & Coughnowr D.R., "Process Systems Analysis and Control", McGraw Hill Inc., New York, 1986. |
| 5 | Eckman D.P., "Industrial Instrumentation", Wiley Eastern Limited, 1990. |

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

# B. Tech.-IV (Ind. Chem.) (Sem. – VII)

| Sr. No. | Subject | Code | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---|---|---|---|---|---|
| | **Seventh Semester (4th year of B. Tech. Ind. Chem.)** | | | | |
| 1 | Purification and Separation Techniques | IC401 | 3-0-2 | 4 | 85 |
| 2 | Elective | IC4XX | 3-0-0 | 3 | 55 |
| 3 | Elective | IC4YY/ CH4YY | 3-0-0/ 3-1-0 | 3/4 | 55/70 |
| 4 | Elective | IC4AA/ CH4AA | 3-0-0 | 3 | 55 |
| 5 | Elective | IC4BB/ CH4BB | 3-0-0 | 3 | 55 |
| 6 | Project-II | IC402 | 0-0-8 | 4 | 120 |
| | | | **Total** | **20/21** | **415/430** |
| 7 | Vocational Training / Professional Experience (Optional) (mandatory for exit) | CYV07 / CYP07 | 0-0-10 | 5 | 200 (20 x 10) |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B.Tech.- IV (Ind. Chem.), Semester – VII<br>INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS<br>IC401 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Interpret the role of analytical techniques in separation and identification of various chemical species. |
| CO2 | Acquire a deep knowledge on chromatography. |
| CO3 | Apply the basics of the separation and chromatographic techniques in multidisciplinary areas |
| CO4 | Develop the skill to apply the advances in thermal methods in advance applications. |
| CO5 | Propose the importance of electro analytical techniques in industrial use. |

| 2. | Syllabus | |
|---|---|---|
| | **CHROMATOGRAPHY** | **(08 Hours)** |
| | Principle, methods of elution, ideal and non-ideal chromatography, plate theory, rate theory, reasons for broadening of lands, Van-Deemter equation and significance of terms involved, optimum velocity, resolution, methods to improve resolution, introduction to chromatographic techniques: paper chromatography, Thin Layer Chromatography (TLC) and Column Chromatography. | |
| | **GAS CHROMATOGRAPHY (GC)** | **(08 Hours)** |
| | Principle, different types of GC, mobile phase and criteria for its selection, stationary phase, sample introduction system, columns, Stationary phases used in GSC and GLC, difference between GSC and GLC, supports for liquid stationary phases, Selection of columns, packed, WCOT, SCOT, FSOT, Detectors: FID, TCD, FPB, ECD, TID - merits and demerits, temperature programming in GC, derivatisation in GC, Qualitative analysis from retention parameters, Quantitative analysis. | |
| | **LIQUID CHROMATOGRAPHY** | **(08 Hours)** |
| | Principle of LC, instrument and significance of each component, Pumps, Guard column, Stationary phases (solid, liquid), Mobile Phases, Bonded phase supports, Detectors - Fluorescence detector, RI detector, electrochemical detector, Normal phase and Reversed phase. | |
| | **POLAROGRAPHY** | **(08 Hours)** |
| | Origin of polargraphy, Current-voltage relationship, Theory of polarographic waves (DC and sampled DC polarograms), Instrumentation, Ilkovič equation, Qualitative and quantitative applications | |
| | **CYCLIC VOLTAMMETRY AND AMPEROMETRY** | **(08 Hours)** |
| | Principle, instrumentation, Randles Sevcik equation, Applications (cyclic voltamogram of $K_3[Fe(CN)_6]$), amperometric titrations. | |
| | **THERMAL METHODS** | **(05 Hours)** |
| | Introduction and instrumentation – thermometric titration –titration of mixture of $Ca^{2+}$ and $Mg^{2+}$ | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | with EDTA – titration of sodium melanate with $HClO_4$ – direct injection enthalpy. | |
| | **Practical will be based on the coverage of the below topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| **3.** | **Practical will be based on** |
|---|---|
| 1 | Separation and identification the given amino acids by Ascending Paper Chromatography. |
| 2 | Determine the caffeine content in tea, coffee, and energy drinks using HPLC. |
| 3 | Analyze the active ingredients in commercial painkillers using HPLC. |
| 4 | Analyze the composition of amino acids in protein hydrolysates using reverse phase HPLC. |
| 5 | Separate and quantify catechins and flavonoids using reverse phase HPLC. |
| 6 | Identify and quantify volatile compounds in essential oils using Gas Chromatography. |
| 7 | Measure the ethanol content in wine, beer, and spirits using Gas Chromatography. |
| 8 | Analyze the fatty acid composition of different oils using Gas Chromatography. |
| 9 | Remove or recover metal ions (e.g., $Cu^{2+}$, $Fe^{3+}$, $Ni^{2+}$) from industrial wastewater using ion-exchange chromatography. |
| 10 | Isolate and purify proteins based on their charge using ion-exchange chromatography. |
| | |

| **4.** | **Books Recommended** |
|---|---|
| 1 | G. D. Christian, P. K. Dasgupta, K. A. Schug, Analytical Chemistry, 7$^{th}$Edition, Wiley-Interscience, New Jersey, 2013. |
| 2 | R. M. Verma, Analytical Chemistry - Theory and Practice, 3$^{rd}$Edition, CBS Publication, New Delhi, 2018. |
| 3 | J. M. Miller, Chromatography Concepts and Contrasts, 2$^{nd}$Edition, Wiley-Interscience, New Jersey, 2005. |
| 4 | D. A. Skoog, F. J. Holler, S. R. Crouch, Principles of Instrumental Analysis, 7$^{th}$Edition, Cengage Learning, Massachusetts, 2017. |
| 5 | H. M. McNair, J. M. Miller, N. H. Snow, Basic Gas Chromatography, 3$^{rd}$ Edition, John Wiley Interscience, 2019. |

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
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**B.Tech. in Industrial Chemistry**

# B. Tech.-IV (Ind. Chem.) (Sem. – VIII)

| Sr. No. | Subject | Code | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---|---|---|---|---|---|
| | **Eighth Semester (4th year of B. Tech. Ind. Chem.)** | | | | |
| 1 | Industrial Internship / Professional Experience(Mandatory) | CYP10 | 0-0-40 | 20 | 800 (40 X 20 ) |
| | | | **Total** | **20** | **800** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry
**(Optional Core(s))**

| B. Tech. – II (Ind. Chem.), Semester – III | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **FOOD TECHNOLOGY**<br>**IC233** | | **3** | **0** | **2** | **04** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course the students will be able to:** |
|---|---|
| CO1 | To identify the different types of biomolecules such as carbohydrates, proteins, lipids and vitamins. |
| CO2 | Distinguish and compare variety of food products based on their structures and functions. |
| CO3 | Analyse various methods for determination and isolation of microorganisms in food. |
| CO4 | Understanding of various physical and chemical properties of food. |
| CO5 | Create a deep insight into different types of chemicals used for the preservation of food. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **Food Chemistry and Nutrition** | **(12 Hours)** |
| | **Carbohydrates**: Structure and functional properties of mono-, oligo-, & poly-saccharides including starch, cellulose, pectic substances and dietary fibre, gelatinization and retrogradation of starch.<br>**Proteins**: classification and structure of proteins in food, biochemical changes in post mortem and tenderization of muscles.<br>**Lipids**: Classification and structure of lipids, rancidity, polymerization and polymorphism.<br>Pigments: carotenoids, chlorophylls, anthocyanins, tannins and myoglobin.<br>**Food Flavours**: Terpenes, esters, aldehydes, ketones and quinines. Enzymes: specificity, simple and inhibition kinetics, coenzymes, enzymatic and non- enzymatic browning.<br>**Nutrition**: Balanced diet, essential amino acids and essential fatty acids, protein efficiency ratio, water soluble and fat soluble vitamins, role of minerals in nutrition, co-factors, anti-nutrients, nutraceuticals and nutrient deficiency diseases.<br>**Chemical and Biochemical Changes**: Changes occurring in foods during different processing. | |
| | **FOOD MICROBIOLOGY** | **(10 Hours)** |
| | **Characteristics of Microorganisms**: Morphology of bacteria, yeast, mold and actinomycetes, spores and vegetative cells,<br>**Microbial Growth**: Growth and death kinetics, serial dilution technique. gram-staining.<br>**Food Spoilage**: Spoilage microorganisms in different food products including milk, fish, meat, egg, cereals and their products.<br>**Toxins from Microbes**: Pathogens and non-pathogens including Staphylococcus, Salmonella, Shigella, Escherichia, Bacillus, Clostridium, and Aspergillus genera.<br>**Fermented Foods and Beverages**: Curd, yoghurt, cheese, pickles, soya-sauce, sauerkraut, idli, dosa, vinegar, alcoholic beverages and sausage. | |
| | **FOOD PRODUCTS TECHNOLOGY** | **(13 Hours)** |
| | **Processing Principles**: Thermal processing, chilling, freezing, dehydration, addition of preservatives and food additives, irradiation, fermentation, hurdle technology, intermediate | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | moisture foods. Food pack aging and storage: packaging materials, aseptic packaging, controlled and modified atmosphere storage. Cereal processing and products: milling of rice, wheat, and maize, parboiling of paddy, bread, biscuits, extruded products and ready to eat breakfast cereals.<br>**Oil Processing**: Expelling, solvent extraction, refining and hydrogenation.<br>**Fruits and Vegetables Processing**: Extraction, clarification, concentration and packaging of fruit juice, jam, jelly, marmalade, squash, candies, tomato sauce, ketchup, and puree, potato chips, pickles.<br>**Plantation crops processing and products**: Tea, coffee, cocoa, spice, extraction of essential oils and oleoresins from spices.<br>**Milk and Milk Products Processing**: Pasteurization and sterilization, cream, butter, ghee, ice-cream, cheese and milk powder. Processing of animal products: drying, canning, and freezing of fish and meat; production of egg powder.<br>**Waste Utilization**: Pectin from fruit wastes, uses of by-products from rice milling. Food standards and quality: FPO, PFA, A-Mark, ISI, HACCP, food plant sanitation and cleaning in place (CIP). | |
| | **FOOD ENGINEERING** | **(10 Hours)** |
| | Mass and energy balance.<br>**Momentum Transfer**: Flow rate and pressure drop relationships for Newtonian fluids flowing through pipe, Reynolds number. Heat transfer: heat transfer by conduction, convection, radiation, heat exchangers.<br>**Mass Transfer**: Molecular diffusion and Flick's law, conduction and convective mass transfer, permeability through single and multilayer films.<br>**Mechanical Operations**: Size reduction of solids, high pressure homogenization, filtration, centrifugation, settling, sieving, mixing & agitation of liquid. Thermal operations: thermal sterilization, evaporation of liquid foods, hot air drying of solids, spray and freeze-drying, freezing and crystallization.<br>**Mass Transfer Operations**: Psychometric, humidification and dehumidification operations. | |
| | **(Total Lecture Hours: 45)** | |
| | **The practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| **3.** | **Practical will be based on** |
|---|---|
| 1 | Estimation of Lactose in Milk. |
| 2 | Estimation of Ascorbic Acid in Foods. |
| 3 | Gram staining of Bacteria in Food. |
| 4 | Estimation of Reducing and Non-Reducing Sugars in Honey by Lane Eynon Method. |
| 5 | Estimation of Proteins in Food Using the Biuret Method. |
| 6 | Evaluation of Sensory Characteristics of Bakery Products. |
| 7 | Detection of Adulterants in Foods. |
| 8 | Detection of Heavy Metals, Insecticides and Pesticides in Foods. |
| 9 | Emulsions and Emulsifying Agents – Preparation of Mayonnaise and Vinaigrettes. |
| 10 | Estimation of Colours in Foods. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**
**Department of Chemistry**
**B.Tech. in Industrial Chemistry**

| **4.** | **Books Recommended** |
|---|---|
| 1 | Roday, S., 2008, Food science and nutrition. Third edition, Oxford University Press, New Delhi. |
| 2 | Ray B and Bhunia A. 2013. Fundamental Food Microbiology. Fifth Edition. CRC Press. |
| 3 | Srinivasan, Damodaran, Kirk, L. Park and Owen R. Fennema. 2008. Food Chemistry, CRC Press, Taylor and Francis Group, New York. |
| 4 | Robertson GL. 2016. Food Packaging Principles and Practice. Third Edition. CRC Press. |
| 5 | Fellows PJ. 2016. Food Processing Technology Principles and Practice. Fourth Edition. Woodhead Publishing. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B.TECH.- II (Ind. Chem.), SEMESTER – IV<br>ELECTROCHEMISTRY<br>IC234 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Learn the advances in electrodes and electrolytic reactions. |
| CO2 | Interpret the theories of electrolytic solutions. |
| CO3 | Calculate the conductance and potential of electrolytic solutions |
| CO4 | Analyze electrochemical cells and electrochemical reactions. |
| CO5 | Justify the electrochemical applications in chemical industries. |

| 2. | Syllabus | |
|---|---|---|
| | **EQUILIBRIUM IN ELECTROLYTE SOLUTIONS** | **(4 Hours)** |
| | Thermodynamic foundations of theory of ionic interaction, Distribution of ions in solution, Debye-Huckel Theory, Calculation of activity coefficient, Numericals. | |
| | **ELECTRICAL CONDUCTANCE OF ELECTROLYTIC SOLUTIONS** | **(12 Hours)** |
| | Ionic conductors, Mixed conductors, Specific conductance, Equivalent conductance, Equivalent conductance at infinite dilution, Transport numbers, Hittorf's method, Moving boundary method, Effect of concentration, temperature and pressure on conductance, conductometry, High frequency conductometry, Debye-Onsager theory of conductance, Electrophoretic effect, Relaxation effect, Wien effect, Debye-Falkenhagen effect. | |
| | **EQUILIBRIUM ELECTRODE POTENTIAL** | **(12 Hours)** |
| | Nernst equation, Electrode potential, Standard emf, Standard electrodes, Types of electrodes- first kind, second kind, metal-metal oxide electrodes, gas electrodes, amalgam electrodes, redox electrodes, glass electrodes, Potentiometry, Electrochemical cells, concentration cell, liquid junction, liquid junction potential, Chemical cells, Double chemical cells, complex chemical cells. | |
| | **IRREVERSIBLE ELECTRODE PROCESSES** | **(10 Hours)** |
| | Faraday's law of electrolysis, current efficiency, Electroanalysis, Coulometry, Electrode polarization, Overpotential, Types of overpotential, Factors affecting overpotential, Hydrogen evolution reaction, hydrogen overpotential-mechanism, factors affecting hydrogen overpotential, Tafel equation, Oxygen evolution reaction. | |
| | **ELECTROCHEMISTRY IN INDUSTRIES** | **(7 Hours)** |
| | Batteries, Li-ion Batteries, Fuel Cells, Elecrtroplating, Metallurgy, Chlor-alkali industry, $CO_2$ reduction, Hydrogen storage, Electroanlytical techniques – cyclic voltammetry, Electrocatalysts. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| **3.** | **Practicals will be based on** |
|---|---|
| 1 | Demonstration of pH electrode, Ag-AgCl electrode and Platinum electrode. |
| 2 | Determination of redox potential of a redox system. |
| 3 | Determination of pH of a solution using potentiometer. |
| 4 | Determination dissociation constant of a weak acid using potentiometer. |
| 5 | Determination of a cell constant of a conductometer. |
| 6 | Analysis of acid mixture using conductometer. |
| 7 | Determination of Chloride concentration by conductometric titration. |
| 8 | Conductometric titration of a strong acid against weak acid. |
| 9 | Potentiometeric titration of Phosphoric acid. |
| 10 | Determination of the solubility product of a sparingly soluble salt. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | S. Arrhenius, Text-Book of Electrochemistry, MJP Publishers, Delhi, India, 2023. |
| 2 | S. Glasstone, An Introduction To Electrochemistry, Legare Street Press, UK, 2022. |
| 3 | J. Bockris, Modern Electrochemistry 2Ed Vol 1 Ionics, Springer, Germany, 2018. |
| 4 | N. Eliaz, E Gileadi, Physical Electrochemistry: Fundamentals, Techniques, and Applications 2$^{nd}$ Ed., Wiley-VCH, UK, 2018. |
| 5 | J. Wang, Analytical Electrochemistry 4th Ed., Wiley-Blackwell, India, 2023. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B.Tech.- II (Ind. Chem.), Semester – IV<br>ORGANOMETALLIC CHEMISTRY<br>IC235 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 04 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Interpret the structure and bonding aspects of organometallic compounds. |
| CO2 | Discuss the stability and reactivity of organometallic complexes. |
| CO3 | Predict the chemical behavior and reactivity of transition metal organometallic compounds. |
| CO4 | Apply different electron counting rules to predict the shape/geometry of metal carbonyl clusters. |
| CO5 | Explore the applications of organometallics in catalysis. |

| 2. | Syllabus | |
|---|---|---|
| | **METALLOORGANIC CHEMISTRY-I** | **(09 Hours)** |
| | Introduction, Classification based on the nature of metal-carbon bond including π-metal complexes, Hapticity (η), General methods of preparations and properties, Organometallic compounds of alkali metals, Be, Mg, Al, Metal olefin complexes; Metal-alkynyl complexes, Cyclopentadienyl complexes: Metallocenes, Synthesis and properties of ferrocene, Reactions of ferrocene, Synthesis, structure and properties of metal-sandwich compounds, Synthesis and reactions of metal-hydrides. | |
| | **METALLOORGANIC CHEMISTRY-II** | **(12 Hours)** |
| | Organometallic compounds: Metal alkyls, Metal aryls, Electron-deficient Organometallic compounds, Electron-rich organometallics, Agostic interaction, Transition metal π complexes with unsaturated organic ligands, Fluxionality in organometallic complexes, 18-electron rule and stability of organotransition metal compounds. Important reactions of Grignard reagent and Organo copper reagent, Synthesis and reactions of metal-carbenes and carbynes. | |
| | **METAL CARBONYLS AND CLUSTERS** | **(12 Hours)** |
| | Metal carbonyls, Structure and bonding in mononuclear metal carbonyls, Metal clusters, Carbonyl clusters, Low nuclearity carbonyl clusters, High nuclearity carbonyl clusters, Electron counting scheme, Wade's rules, Halide type clusters, Boranes and metalloboranes, Carboranes, Metal–metal single and multiple bond clusters, Isolobal analogy. | |
| | **ORGANOMETALLIC COMPOUNDS IN HOMOGENEOUS CATALYSIS** | **(12 Hours)** |
| | Homogeneous catalysis: Hydrogenation, Hydroformylation, and Polymerization of olefins (Ziegler-Natta catalysis), Mechanism of homogeneous catalysis reactions – Oxidative-addition, Reductive-elimination, β-migratory insertion, Sigma bond metathesis, Transmetallation, Ligand substitution reactions, Wacker's oxidation, Water gas shift reactions and Fischer-Tropsch process, Monsanto acetic acid process, Olefin metathesis, C-C coupling reactions. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| **3.** | **Practicals will be based on** |
|---|---|
| 1 | Analysis of Ternary mixtures: $Ag^{+}$, $Cu^{2+}$, and $Ni^{2+}$. |
| 2 | Analysis of Ternary mixtures: $Cu^{2+}$, $Ni^{2+}$ and $Zn^{2+}$. |
| 3 | Analysis of Ternary mixtures: $Fe^{3+}$, $Mg^{2+}$, and $Ca^{2+}$. |
| 4 | Given a solution of $BaCl_2$ and $CaCl_2$ determine the amount of Ba gravimetrically and Ca volumetrically by oxalate method. |
| 5 | To prepare the tetra amine copper (II) sulfate monohydrate complex $[Cu(NH_3)_4(H_2O)]SO_4$ from copper sulfate ($CuSO_4.5H_2O$). To estimate the amount of Cu in the prepared sample volumetrically. |
| 6 | To estimate gravimetrically, the amount of lead present in the lead acetate (or lead nitrate) solution by precipitating it as lead chromate. |
| 7 | Preparation and characterization of metal complex $K_3[Cr(C_2O_4)_3]$. |
| 8 | Preparation and characterization of metal complex $[Mn(acac)_2]$. |
| 9 | Preparation and characterization of metal complex Prussian blue. |
| 10 | Preparation and characterization of metal complex Turnbull blue. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | BD Gupta and AJ Elias, Basic Organometallic Chemistry- Concepts, Synthesis, and Applications, Universities Press Private Limited, India, 2011. |
| 2 | J. Hartwig, Organotransition Metal Chemistry: From Bonding to Catalysis, 1st Edition, University Science Books, USA, 2009. |
| 3 | R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, 6th Edition, John Wiley & Sons, New York, 2014. |
| 4 | D. F. Shriver and P. W. Atkins, Inorganic Chemistry, Oxford University Press, 4th Edition, London, 2006. |
| 5 | J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi, Inorganic Chemistry-Principles of Structure and Reactivity, 4th Edition, Pearson Education, London, 2006. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – V | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **INDUSTRIAL INORGANIC CHEMISTRY**<br>**IC332** | | **3** | **0** | **0** | **03** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Understand industrial requirements and synthesis of inorganic compounds. |
| CO2 | Explain the economic significance and industrial applications of inorganic compounds. |
| CO3 | Describe the manufacturing processes and chemical synthesis of fertilizers. |
| CO4 | Classify inorganic polymers based on their structure and composition. |
| CO5 | Assess the applications of inorganic polymers in various industries. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **INDUSTRIAL PRODUCTION AND APPLICATION** | **(10 Hours)** |
| | Hydrogen: Economic Importance, Hydrogen Manufacture, Petrochemical Processes, Hydrogen Applications; Ammonia: Economic Importance, Synthetic Ammonia Manufacture, Hydrazine, Economic Importance, Manufacture of Hydrazine, Applications of Hydrazine, Hydroxylamine: Manufacture, Raschig Process. | |
| | **INORGANIC COMPOUNDS** | **(10 Hours)** |
| | Nitrogen and Nitrogen Compounds: Conversion of Synthesis Gas to Ammonia, Phosphorus and its Compounds, Phosphorus and Inorganic Phosphorus Compounds, Phosphoric Acid; Sulfur and Sulfur Compounds: Sulfur, Economic Importance, Applications, Sulfuric Acid, Fluorine and Fluorine Compounds, Chlorine, Sodium Hydroxide, Hydrochloric Acid and Iodine Compounds. | |
| | **FERTILIZERS** | **(12 Hours)** |
| | Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammonium phosphates; Polyphosphate, Super phosphate, Compound and mixed fertilizers Potassium Chloride, Potassium sulphate. | |
| | **INORGANIC POLYMERS** | **(13 Hours)** |
| | Introduction, Classification of inorganic polymers, General properties of inorganic polymers, Characterization of inorganic polymers, Crystalline and amorphous polymers, Important inorganic polymers: phosphorus based polymers, Sulphur-based polymers, Boron-based polymers, Silicon based polymers. | |
| | **(Total Contact Time: 45 Hours)** | |

| **3.** | **Books Recommended** |
|---|---|
| 1 | O.P. Vermani, A.K. Narula, Applied Chemistry, Theory and Practice, second edition, 1995, New Age International (P) Ltd., Publishers Published by New Age International (P) Ltd., Publishers, ISBN (13) : 978-81-224-2494-2 |
| 2 | Robert H. Crabtree, The organometallic chemistry of the transition metals, , 4th, Yale University, New Haven, Connecticut,A John Wiley & Sons, Inc., Publication 2005. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| 3 | J.E. Mark, H.R. Allcock, R. West, Inorganic Polymers, 2nd Edition Oxford University Press, Inc., New York. |
| 4 | G.R.Chatwal, Inorganic Polymers, Himalaya Publishing House. |
| 5 | P. Bahadur and N.V Shastry, Principles of Polymer Science, Narosa, New Delhi, 2000. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – VI | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **NUCLEAR CHEMISTRY AND ENERGY**<br>**IC333** | | **3** | **0** | **0** | **03** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Acquire knowledge and understanding on some nuclear models for calculating nuclear properties. |
| CO2 | Interpret the theoretical background for the synthesis and separation of man-made radio isotopes as well elements. |
| CO3 | Correlate fundamental knowledge of mechanism and functioning of nuclear detectors based on interaction radiation on matter. |
| CO4 | Prioritize the knowledge of different types of nuclear reactions, mechanism of nuclear reactions, and calculation of fission probability. |
| CO5 | Justify the relationship between the statistics and radiation detection methods. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **FUNDAMENTALS OF NUCLEAR CHEMISTRY** | **(10 Hours)** |
| | Nuclear angular momentum, magnetic dipole moment and electronic quadruple moment, parity of nuclear energy states, binding energy, nuclear size, root mean square radius of atomic nucleus, nuclear models – nuclear forces, liquid drop model, formulation of semi-empirical binding energy equation, mass parabola, application of binding energy equation, compound nucleus theory (qualitative approach), optical model, , shell model, nuclear magic number and its derivation from nuclear potential well, calculation of nuclear spin, nuclear isomerism. | |
| | **NUCLEAR REACTIONS** | **(10 Hours)** |
| | nuclear reactions – energetics, mechanism, models, nuclear fission and nuclear fusion, Q-value and cross section of nuclear reaction, calculation of fission probability, nuclear reactions in stars, solar neutrino hypothesis, alpha decay paradox - explanation in terms of tunnel effect, explanation of beta and gamma transition, selection rules synthetic elements: theoretical background, production and separation of super heavy elements, production and nuclear properties of transactinide elements, fundamental and experimental aspects of one-atom-at a time chemistry. | |
| | **NUCLEAR EQUILIBRIUM** | **(07 Hours)** |
| | Successive disintegration, Bateman equation, secular and transient equilibrium, no equilibrium; special successive disintegrations, formation of radioelement in a nuclear reaction, hot-atom, positron annihilation, probability of positronium formation, reactions of positronium ion, chemistry of muonium and pionium ions, Szilard-Chalmer reaction, retention of activity, primary and secondary retention, synthesis of labelled compounds, overview of activation analyses. | |
| | **RADIATION AND MATTER** | **(08 Hours)** |
| | Different radiations, quarks, interactions of heavy charged particles, energy loss, collisional and radiative stopping power - related semi-empirical calculations, Bethe formula, mean excitation energy, range, slowing down time, Cerenkov radiation, attenuation coefficient, interaction | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | between electrons & matter, synchrotron radiation, Mu-meson, range-energy relation for mono-energetic electrons, pair production, interaction of neutrons with matter, radiative capture, types of reactors & accelerators, carbides and nitrides as nuclear fuel substrate, four-factor formula, nuclear hazards and nuclear waste. | |
| | **STATISTICAL METHODS IN RADIOACTIVITY** | **(10 Hours)** |
| | Counting statistics, radioactivity as a statistical phenomenon, optimization of counting experiments, types of scintillators – inorganic, organic, liquid scintillators and their applications, scintillation mechanism, semiconductor detectors, gas-filled detectors-principle of operation and applications, Geiger–Müller and proportional counters, classification of nuclear detectors, variation of amplitude vs. voltage - characterization of different zones, role of quench gases - limitations of proportional detectors: proportional counter performance, flow-type proportional counter, gas multiplication factor, space change effects. | |
| | **(Total Contact Time: 45 Hours)** | |

| **3.** | **Books Recommended** |
|---|---|
| 1 | P. A. C. Mcpherson, Principles of Nuclear Chemistry, World Scientific Publishing Europe Ltd, London, UK, 2016. |
| 2 | J. V. Kratz, Nuclear and Radiochemistry: Fundamentals and Applications, WILEY-VCH, NJ, USA, 2022. |
| 3 | J. Hofstader, Nuclear Chemistry, Larsen and Keller Education, New York, USA, 2022. |
| 4 | M. N. Devi, Elements of Nuclear Chemistry, Anmol Publisher, Delhi, 2011. |
| 5 | J. Kónya and N. M. Nagy, Nuclear and Radiochemistry, 2nd Edition, Elsevier Inc., Amsterdam, Netherlands, 2018. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry
### (Elective(s))

| B. Tech. – III (Ind. Chem.), Semester – V<br>INDUSTRIAL APPLICATIONS OF NANOMATERIALS<br>IC351 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 03 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Adapt synthetic procedure for processing of nanomaterials for industrial applications. |
| CO2 | Acquire knowledge about the electronic, mechanical and thermal properties of nanomaterials. |
| CO3 | Illustrate the structure and morphology of nanomaterials. |
| CO4 | Know industrial applications of nanomaterials in sustainable developments and technology. |
| CO5 | Extend the knowledge on the synthetic routes for synthesis of nanomaterials for various industries |

| 2. | Syllabus | |
|---|---|---|
| | **STRUCTURES & CLASSIFICATION OF NANOMATERIALS** | **(10 Hours)** |
| | Definition of Nano, Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, carbon age-new form of carbon nanostructures, influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.<br>Types of nanostructure and properties of nanomaterials: One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties. | |
| | **SYNTHETIC ROUTES OF NANOMATERIALS** | **(18 Hours)** |
| | Principle and relative merits of each technique for production of Nano-structures including ultra-thin films and multilayer by: (a) Laser Ablation technique, (b) Arc Discharge technique and (c) Mechanical Milling. Physico-chemical methods such as Chemical Vapor Deposition (CVD), Plasma, Sputtering, Hot-Wire Plasma Enhanced CVD method, and Self-assembly technique.<br>Chemical methods: Synthesis of nanomaterials by precipitation and co-precipitation methods, Sol-Gel synthesis, Microemulsions synthesis, Hydrothermal and Solvothermal methods. Microwave assisted synthesis, Sonochemical assisted synthesis. Metal nanocrystals synthesis by polyol, and borohydrate reduction methods, Photochemical synthesis, Synthesis in supercritical fluids and Electrochemical synthesis, Synthesis of Core-Shell nanostructure, Organic –Inorganic Hybrids, Quantum dots (QDs), Carbon Nanotubes, Graphenenanosheets. Biological methods: Use of bacteria, and fungi. | |
| | **PROPERTIES, CHARACTERIZATION AND APPLICATIONS OF NANOMATERIALS** | **(17 Hours)** |
| | Properties and size effect of nanomaterials, electrical, Mechanical, Magnetic, Optical and catalytic properties, Analytical techniques for the characterization of nanostructure materials, Applications of nanomaterials in analytical chemistry, organic chemistry, biomedical sciences and sustainable development and technology. | |
| | | **(Total Contact Time: 45 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| 3. | Books Recommended |
|---|---|
| 1 | G. A. Ozin, A. C. Arsenault, L. Cademartiri, Nanochemistry: A Chemical Approach to Nanomaterials, 2nd Edition, The Royal Society of Chemistry, Cambridge, 2009. |
| 2 | C. N. R Rao, A. Muller, A. K Cheetham, Nanomaterials Chemistry, 1st Edition, Wiley-VCH, 2007. |
| 3 | G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties, and Applications, 1st Edition, Imperial College Press, London, 2004. |
| 4 | M. Hosokawa, K. Nogi, M. Naito, Y. Yokoyama, Nanoparticles Technology Handbook, 1st Edition, Elsevier, 2007. |
| 5 | T. Pradeep, Nano the Essentials: Understanding Nanoscience and Nanotechnology, 1st Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – VI | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **PHYSICAL ASPECTS OF MOLECULAR SPECTROSCOPY**<br>**IC352** | | **3** | **1** | **0** | **04** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Gain fundamental knowledge of electromagnetic spectrum. |
| CO2 | Employ concepts of molecular spectroscopy and selection rules. |
| CO3 | Learn the structural elucidation by molecular spectroscopy. |
| CO4 | Demonstrate structural characterization of a molecule through spectroscopy. |
| CO5 | Apply selection rules in rotational, IR and Raman spectroscopy. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **THE WAVE PHENOMENA** | **(15 Hours)** |
| | The Electromagnetic spectrum. General nature of electromagnetic waves; wave parameters, radiant power (Intensity), superposition of waves, diffraction, transmission, dispersion, refraction, reflection, scattering and polarization of radiation. Interaction of light and matter. Born-Oppenheimer approximation, Signal to noise ratio, Width and intensity of transition, line broadening. | |
| | **MICROWAVE SPECTROSCOPY** | **(15 Hours)** |
| | Pure Rotational Spectra – Microwave Spectroscopy. Rotational constant, moment of inertia and rotational energy levels of diatomic molecules. Rigid rotor (diatomic only), Selection rule, Spectrum: position and intensity of spectral lines. Non-rigid rotor and its effect on energy levels, Selection rule and spectrum, Isotope effect, Rotational spectra of polyatomic molecules. Numericals. | |
| | **VIBRATIONAL (IR AND RAMAN) SPECTROSCOPY** | **(15 Hours)** |
| | Polarizability, dipole moment, Rotational Raman spectra. Vibrational Spectroscopy (IR and Raman) – Diatomic Molecules. The vibrations of diatomic molecules. The harmonic oscillator. Selection rules and infrared spectra of diatomic molecules. Anharmonicity. Vibration-rotation spectra. Vibrational Raman spectra, Isotope effect, the rule of Mutual Exclusion, vibrational modes of functional groups. Structure elucidation. Numericals. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| **3.** | **Tutorials** |
|---|---|
| 1 | Problem based on Electromagnetic spectrum. |
| 2 | Problems based on superposition of waves, diffraction, transmission, dispersion, refraction, reflection, scattering and polarization of radiation. |
| 3 | Problem based on Interaction of light and matter. Born-Oppenheimer approximation. |
| 4 | Problems based on signal to noise ratio, Width and intensity of transition, line broadening. |
| 5 | Problems based on moment of inertia. |
| 6 | Problems based on Rotational constant. |
| 7 | Problem based on Rigid rotor (diatomic only), Selection rule, Spectrum: position and intensity of spectral lines. |
| 8 | Problems based on Isotope effect, Rotational spectra of polyatomic molecules. |
| 9 | Problems based on Vibrational Spectroscopy (IR and Raman). |
| 10 | The harmonic oscillator. Selection rules and infrared spectra of diatomic molecules. |
| 11 | Problems based on anharmonicity. Vibration-rotation spectra. Vibrational Raman spectra, Isotope effect. |
| 12 | Vibrational modes of functional groups. |
| 13 | Structure elucidation-I based on microwave, IR and RAMAN. |
| 14 | Structure elucidation-II based on microwave, IR and RAMAN. |
| 15 | Structure elucidation-III based on microwave, IR and RAMAN. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | J. M. Hollas, Modern Spectroscopy, $4^{th}$ Edition, Wiley, 2004. |
| 2 | C. N. Banwell, Elaine M. Mc Cash, Fundamentals for Molecular Spectroscopy, $4^{th}$Edition, McGraw-Hill, 1994. |
| 3 | N. Levine, Quantum Chemistry, $4^{th}$ Edition, Prentice Hall, Englewood Cliffs, New Jersey, 1991. |
| 4 | G. M. Barrow, Physical Chemistry, $6^{th}$ Edition, McGraw-Hill, Kogakusha Ltd., New Delhi, 1973. |
| 5 | S. Maity, N. Ghosh, Physical Chemistry Practical, $1^{st}$ Edition, New Central Book Agency (P) Ltd., India, 2012. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – V | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **COMPUTATIONAL METHODS IN CHEMISTRY**<br>**IC353** | | **3** | **0** | **2** | **04** |

| 1. | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Describe the theoretical concepts of molecular mechanics and geometry optimizations. |
| CO2 | Predict excited state geometry and properties in order to calculate molecular spectroscopy based parameters. |
| CO3 | Compare the theoretical data with experimental spectra. |
| CO4 | Explore molecular dynamic simulations. |
| CO5 | Explain and perform molecular docking with suitable examples. |

| 2. | **Syllabus** | |
|---|---|---|
| | **AB INITIO CALCULATIONS** | **(12 Hours)** |
| | Principles of ab initio method, Hartree SCF method, Hartree–Fock equations, basis sets, Gaussian functions; basis set preliminaries; direct SCF, types of basis sets and their uses, post-Hartree–Fock calculations, electron correlation, Møller–Plesset approach to electron correlation, configuration interaction approach to electron correlation - coupled cluster method, applications of ab initio method – geometries, energies, frequencies and vibrational spectra, bond orders, Atoms-in-Molecules (AIM), other important properties -, ionization energies, and electron affinities, strengths and weaknesses of ab initio calculations. | |
| | **SEMIEMPIRICAL AND DFT CALCULATIONS** | **(12 Hours)** |
| | Principles of SCF semiempirical methods, Pariser-Parr-Pople (PPP) method, Complete Neglect of Differential Overlap (CNDO) method, Intermediate Neglect of Differential Overlap (INDO) method, Neglect of Diatomic Differential Overlap (NDDO) method, Principles of density functional theory (DFT), previous DFT methods, Kohn–Sham approach, Kohn–Sham Approach, applications of semiempirical and DFT methods – geometries, energies, frequencies and vibrational spectra, properties arising out of electron distribution – dipole moments, charges, bond orders, other important properties - UV and NMR spectra, ionization energies, and electron affinities, strengths and weaknesses of semiempirical and DFT methods. | |
| | **SOLVATION, DIRADICALS AND HEAVY ATOMS** | **(06 Hours)** |
| | Solvation, ways of treating solvation, singlet diradicals - model chemistries and beyond model chemistries, Complete Active Space (CAS) calculations, heavy atoms and relativistic corrections, heavy atom calculations, transition metals. | |
| | **MOLECULAR MECHANICS** | **(08 Hours)** |
| | History and fundamental assumptions, potential energy functional forms, bond stretching, valence angle bending, torsions, van der Waals interactions, electrostatic interactions, cross terms and additional non-bonded terms, parameterization strategies, force-field energies and thermodynamics, geometry optimization, optimization algorithms, optimization aspects specific to force fields, | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | menagerie of modern force fields, available force fields, validation, force fields. | |
| | **MOLECULAR DOCKING** | **(07 Hours)** |
| | Docking, basic theories and algorithms used on docking, rigid docking, flexible docking, manual docking, applications of docking – receptor –ligand binding, virtual screening, drug discovery, protein – protein interaction, enzymatic studies, software available for docking and their uses. | |
| | **Practical will be based on the coverage of the above topics separately** | **(30 Hours)** |
| | **(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)** | |

| **3.** | **Practical will be based on** |
|---|---|
| 1 | Demonstration of chemical structure drawing program ChemDraw and molecular modelling counterpart Chem3D to draw and manipulate different organic chemistry structures. |
| 2 | Drawing chemical structure with ChemDraw and Chem3D. |
| 3 | Geometry optimization techniques and their effect on geometry, energy and frequencies with butane as an example using Gaussian 09W. |
| 4 | Location of different conformations and transition states in 1,2 – dichloroethane using Gaussian 09W. |
| 5 | Calculation of IR, Raman and polarizability using the Gaussian 09W and to demonstrate the other importance of frequency calculations. |
| 6 | Calculation of the UV Vis spectrum and emission spectra of acrolein/phenol using CIS/TDDFT method. |
| 7 | Theoretical prediction of 1H and 13C NMR spectra and spin-spin coupling constants of ethanol. |
| 8 | Calculation of vibrational circular dichroism (VCD) Electronic circular dichroism (ECD), and Optical rotary dispersion (ORD) using the Gaussian 09W. |
| 9 | Demonstration of molecular dynamic simulation with Gromacs/Amber. |
| 10 | Demonstration of molecular docking with Autodock. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | F. Jensen, Introduction to Computational Chemistry, 3rd Edition, John Wiley & Sons, Ltd,Chichester, UK, 2017. |
| 2 | E.G. Lewars, Computational Chemistry, 3rd Edition, Springer, Switzerland, 2016. |
| 3 | T. Chakraborty, P. Ranjan, A. Pandey, Computational Chemistry Methodology in Structural Biology and Materials Sciences, 1st Edition, Apple Academic Press, New York, 2017. |
| 4 | J. Schrier, Introduction to Computational Physical Chemistry, University Science Books, Mill Valley, California, 2017. |
| 5 | J. Leszczynski, Handbook of Computational Chemistry, 2nd Edition, Springer, New York, 2017. |

| **5.** | **Additional Reading Material** |
|---|---|
| 1 | D. Bove, Computational Chemistry: Theories, Methods and Applications, Nova Science Publishers, Inc.,New York, 2014. |
| 2 | A. Kukol, Molecular Modelling of Proteins, 2nd Edition, Springer, New York, 2015. |

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# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – VI | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **MOLECULAR SPECTROSCOPY**<br>**IC354** | | **3** | **1** | **0** | **04** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Understand the theories and basic principles of spectroscopic techniques. |
| CO2 | Acquire knowledge on the effect of solvent and hydrogen bonding on vibrational frequencies. |
| CO3 | Identify the organic functional groups by spectroscopic techniques. |
| CO4 | Learn gas-phase reactions and to predict the fragmentation of organic molecules by mass spectrometry. |
| CO5 | Elucidate an unknown structure, or solve a structure-related problem by utilizing spectroscopic data. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **UV-VISIBLE ABSORPTION AND EMISSION SPECTROSCOPY** | **(10 Hours)** |
| | Mechanism of absorption and emission of radiation by organic compounds, shape of absorption and emission bands and Franck-Condon principle. Various electronic transitions, Lambert-Beer law, effect of solvent on electronic transition, Ultraviolet bands for carbonyl compound, unsaturated carbonyl compounds, conjugated unsaturated compounds, Woodward-Fieser's rules for conjugated dienes and unsaturated carbonyl compounds, UV spectra of aromatic and heterocyclic compounds steric effect in biphenyls. Principles, origin of fluorescence and phosphorescence spectra, instrumentation and applications. | |
| | **INFRARED SPECTROSCOPY** | **(08 Hours)** |
| | Principle, Instrumentation and sample handling, modes of vibrations, force constant and bond strengths, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines, carbonyl compounds, esters, amides, anhydrides, lactones and lactams. Effect of solvent and hydrogen bonding on vibrational frequencies, overtones, IR of gaseous, solids and polymeric materials. | |
| | **NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY** | **(16 Hours)** |
| | NMR phenomenon, spin ½ nuclei, ($^{1}$H, $^{13}$C, $^{31}$P and $^{19}$F), Zeeman splitting, effect of magnetic field strength on sensitivity and resolution, chemical shift δ, inductive and anisotropic effects on δ, chemical structure correlations of δ, chemical and magnetic equivalence of spins, spin-spin coupling, structural correlation to coupling constant J, selective decoupling, use of chemical shift reagents for stereochemical assignments. $^{13}$C NMR, introduction to FT technique, relaxation phenomena. | |
| | **MASS SPECTROMETRY** | **(11 Hours)** |
| | Basic principles, ionization techniques, isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution MS, soft ionization methods, ESI-MS and MALDI-MS, illustrative examples from macromolecules and | |

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| | | |
|---|---|---|
| | supramolecules, Fragment ions of odd and even electron types – rearrangement ions – factors affecting cleavage patterns –simple and multicentre fragmentation – McLafferty rearrangement – Retro Diels-Alder fragmentation. Mass spectra of hydrocarbons, alcohols, phenols, aldehydes, ketones, carboxylic acids, amines and their derivatives. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** | |

| **3.** | **Tutorials** |
|---|---|
| 1 | Calculations based on Woodward-Fieser rules for Absorption maxima of various organic compounds |
| 2 | Spectral problems for identification of organic compound 1 |
| 3 | Spectral problems for identification of organic compound 2 |
| 4 | Spectral problems for identification of organic compound 3 |
| 5 | Spectral problems for identification of organic compound 4 |
| 6 | Spectral problems for identification of organic compound 5 |
| 7 | Spectral problems for identification of organic compound 6 |
| 8 | Spectral problems for identification of organic compound 7 |
| 9 | Spectral problems for identification of organic compound 8 |
| 10 | Identification of organic functional groups based on IR and UV spectral data |
| 11 | Identification of isomers by $^{1}H$ and $^{13}C$ NMR spectral data |
| 12 | Identification of aromatic compounds by $^{1}H$ and $^{13}C$ NMR spectral data |
| 13 | Structure determination by NMR and mass spectral data |
| 14 | Identification of metal complex structures by mass spectra |
| 15 | Structure determination by mass spectrometry |

| **4.** | **Books Recommended** |
|---|---|
| 1 | K. W. Silverstein, F. X. Webster, D. J. Kiemle, D. L. Bryce, Spectrometric Identification of Organic Compounds, 8th Edition, John Wiley & Sons, New York, 2014. |
| 2 | J. R. Lakowicz, Principles of Fluorescence Spectroscopy, 3rd Edition, Springer, USA, 2006. |
| 3 | M. Sauer, J. Hofkens, J. Enderlein, Basic Principles of Fluorescence Spectroscopy, Wiley-VCH, New York, 2011. |
| 4 | J. H. Gross, Mass Spectrometry, 2nd Edition, Springer Berlin Heidelberg, Germany, 2011. |
| 5 | G. M. Lampman, D. L. Pavia, G. S. Kria, J. R. Vyvyan, Spectroscopy International Edition, 4th Edition, Cengage Learning India Pvt. Ltd., New Delhi, 2012. |

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# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – IV | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **GROUP THEORY AND MAGNETISM**<br>**IC355** | | **3** | **1** | **0** | **04** |

| 1. | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Learn principles and concepts of symmetry and group theory. |
| CO2 | Understand the use of character tables and projection operator techniques. |
| CO3 | Interpret molecular symmetry, symmetry operations, and molecular point groups. |
| CO4 | Analyze electronic spectra of coordination compounds. |
| CO5 | Describe inorganic magnetism. |

| 2. | **Syllabus** | |
|---|---|---|
| | **SYMMETRY AND GROUP THEORY** | **(25 Hours)** |
| | Symmetry Operations and Elements of Symmetry: Rotational Axis of Symmetry, Plane of Symmetry, Improper Rotational Axis of Symmetry (Alternate Axis of Symmetry), Centre of Symmetry, Identity Element, Cartesian Coordinate System and Symmetry Elements, More about Symmetry Elements, Mathematical requirements for a point group, Group multiplication tables, Group generating elements, Subgroups and Classes-exercises, Point groups, Identification of Molecular point groups, Notation of Point Groups, Systematic assignment of point groups to molecules, Descent in Symmetry of Molecules with substitution, Exercises on Point Groups, Matrix Representations of Symmetry Elements, Reducible and Irreducible Representations, Properties of Irreducible Representations. Great Orthogonality Theorem (G.O.T.), Construction of character tables for $C_{2v}$, $C_{3v}$, $C_{2h,}$ and $C_{4v}$ point groups using G.O.T., Standard reduction formula, IR and Raman active modes of the water molecule, Symmetry restrictions of dipole moment, Symmetry criteria of optical activity, Applications of group theory to chemical bonding. | |
| | **SPECTRA & MAGNETISM OF TRANSITION METAL COMPLEXES** | **(20 Hours)** |
| | The energy terms, coupling schemes, spin-spin coupling, orbital coupling, spin-orbital coupling, R-S coupling, J-J coupling scheme, selection rules, and relaxation of selection rules. Energy levels in an atom, Calculation of the number of the microstates Determining the Ground State, Term Symbols, Terms-Hunds Rule, Hole formulation (derivation of the Term Symbol for a closed sub-shell, derivation of the terms for a $d^2$ configuration), Orgel diagrams for $d^1$ to $d^9$ systems, Electronic spectra of $[Ti(H_2O)_6]^{3+}$, $[Cu(H_2O)_6]^{2+}$, $[V(H_2O)_6]^{3+}$, $[Ni(H_2O)_6]^{2+}$, $[CoF_6]^{3-}$, $[CoCl_4]^{2-}$ and $[NiCl_4]^{2-}$ complexes, Charge transfer spectra, electronic absorption spectra of spin paired complexes, Jahn-Tellar effect and electronic spectra of complexes; properties of paramagnetic complexes, magnetic moment, anti-ferromagnetism and ferromagnetism. | |
| | **Tutorial will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** | |

| 3. | **Tutorials** |
|---|---|
| 1 | Discussion of problems on symmetry operations and elements of symmetry. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| 2 | Discussion of examples on lower-order point groups. |
| 3 | Discussion of examples on higher-order point groups. |
| 4 | Discussion of problems on matrix representation of symmetry elements. |
| 5 | Discussion of problems on reducible representations. |
| 6 | Discussion of problems on irreducible representations. |
| 7 | Discussion of problems on great orthogonality theorem. |
| 8 | Discussion of problems on standard reduction formula. |
| 9 | Discussion of problems on dipole moment. |
| 10 | Discussion of problems with the calculation of the number of microstates. |
| 11 | Discussion of problems on ground state term symbols. |
| 12 | Discussion of examples of electronic spectra of metal complexes. |
| 13 | Discussion of examples of charge transfer spectra. |
| 14 | Discussion of examples of the Jahn-Tellar effect. |
| 15 | Discussion of examples of magnetic properties of metal complexes. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, 4$^{th}$ Edition, Pearson Education India, 2006. |
| 2 | F. A. Cotton, Chemical Applications of Group Theory, 3rd Edition, Wiley, 2008. |
| 3 | H. H. Jaffe, M. Orchin, Symmetry in Chemistry, Dover Publications, 2003. |
| 4 | K. Veera Reddy, Symmetry and Spectroscopy of Molecules, New Age International, 2020, 2nd Edition. |
| 5 | D. F. Shriver and P. W. Atkins, Inorganic Chemistry, Oxford University Press, 2006 and 4th Edition. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – VI | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **PROCESS EQUIPMENT DESIGN**<br>**CH304** | | **3** | **1** | **0** | **04** |

| 1. | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Select appropriate material of construction for various types of process equipments |
| CO2 | Choose appropriate design methodology for designing various parts of process equipments as well as entire vessels |
| CO3 | Design process equipments including pressure vessels, heat exchangers, distillation columns, extraction columns, absorbers, strippers, etc. |
| CO4 | Design process equipments subjected to internal pressure and external pressure |
| CO5 | Analyze the environmental, plant, and personnel safety criteria and implement them in designing process vessels. |
| CO6 | Evaluate design of various process equipments like storage tanks, distillation columns, etc. |

| 2. | **Syllabus** | |
|---|---|---|
| | **INTRODUCTION** | **(03 Hours)** |
| | Introduction to Chemical Engineering Design, Process design, Mechanical aspects of process equipment design, General design procedure, Equipment classifications, Design codes and standards (IS, ASTM and BS) | |
| | **CRITERIA IN VESSEL DESIGN** | **(03 Hours)** |
| | Properties of materials, Material of construction for various equipments and services, Material specifications, Fabrication techniques | |
| | **DESIGN OF PRESSURE VESSELS** | **(12 Hours)** |
| | Design of pressure vessels under internal pressure, Construction features, Pressure vessel code, Design of shell, various types of heads, nozzles, flanges for pressure vessel construction features of thick-walled pressure vessels, Various types of jackets and coils for reactors, Auxiliary process vessels | |
| | **SUPPORTS FOR VESSELS** | **(04 Hours)** |
| | Design consideration for supports for process equipments, Design of brackets support, leg support skirt, support, saddle support. | |
| | **DESIGN OF STORAGE VESSEL** | **(03 Hours)** |
| | Storage of nonvolatile and volatile liquids and gases, Codes for storage vessel design, Bottom, Roof and Shell designs. | |
| | **DESIGN OF VESSELS UNDER EXTERNAL PRESSURE** | **(04 Hours)** |
| | Design criteria for external design pressure, vessels operated under vacuum, Use of stiffeners, Design of covers, pipes and tubes | |
| | **DESIGN OF HEAT EXCHANGERS** | **(08 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | | |
|---|---|---|
| | Types of heat exchangers, Selection criteria, Design of heat exchangers- shell, tube, baffles, closures, channels, tube sheets etc. | |
| | **DESIGN OF DISTILLATION AND ABSORPTION COLUMNS** | **(06 Hours)** |
| | Basic features of tall vertical equipments/ towers, Towers/Column Internal, Design of tower shell and internals, supports etc. | |
| | **PROCESS HAZARDS & SAFETY, MEASURES IN EQUIPMENT DESIGN** | **(02 Hours)** |
| | Equipment testing, Analysis of hazards, Pressure relief devices, Safety measures in process equipment design | |
| | **Tutorial will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **(Total Contact Time: 45 Hours)** | |

| **3.** | **Tutorial will be based on** |
|---|---|
| 1 | Numericals. |
| 2 | Design problems. |
| 3 | Quiz. |
| 4 | Assignments / Mini projects & presentation on related topics. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | V. V. Mahajani, S. B. Umarji, Joshi's Process Equipment Design, 5rd Ed., Laxmi Publ., 2016. |
| 2 | B. C. Bhattacharyya, Introduction to Chemical Equipment Design: Mechanical Aspects, CBS Publishers, New Delhi, 2017. |
| 3 | Indian Standard 2825 (1969). |
| 4 | C. Soares, Process Engineering Equipment Handbook, McGraw-Hill, New York, 2002. |
| 5 | N. P. Cheremisinoff, Handbook of Chemical Processing Equipment, Butterworth Heinemann, Oxford, 2000. |

| **5.** | **Additional Reading Material** |
|---|---|
| 1 | D. Q. Kern, Process Heat Transfer, McGraw-Hill, New York, 1982. |
| 2 | S. Hall, Rules of Thumb for Chemical Engineers, 6th Ed., Elsevier, Oxford, 2017. |
| 3 | Coulson & Richardson's Chemical Engineering, Vol. 6, 4th Ed., Elsevier, New Delhi, 2006. |

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# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – IV (Ind. Chem.), Semester – VII | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **FUEL, PETROLEUM AND PETROCHEMICALS**<br>**IC451** | | **3** | **0** | **0** | **03** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course the students will be able to:** |
|---|---|
| CO1 | Understand basic concepts of various fuels. |
| CO2 | Acquire knowledge of basic concepts of petrochemicals. |
| CO3 | Explore the various synthetic methods of producing fuels. |
| CO4 | Appraise the industrial chemical process of transforming raw materials to petrochemicals. |
| CO5 | Apply the use of synthetic fuels and petrochemicals. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **FUELS** | **(12 Hours)** |
| | Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate)-carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil – cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) – power alcohol and biodiesel. | |
| | **PETROLEUM** | **(08 Hours)** |
| | Origin, formation and composition of petroleum, petroleum processing: fractionation, blending of gasoline, gasoline treatment, kerosene treatment, treatment of lubes, petroleum wax and purification. | |
| | **THERMAL AND CATALYTIC PROCESSES** | **(10 Hours)** |
| | Thermal cracking, catalytic cracking, catalytic reforming, naphtha cracking, coking, hydrogen processes, alkylation, isomerization processes; polymer gasoline, asphalt, upgradation of heavy crudes. | |
| | **PETROCHEMICALS** | **(15 Hours)** |
| | Industrial gases, liquid paraffin, petroleum jelly; Sources of petrochemicals; Synthesis of methanol, formaldehyde, acetylene, synthetic gas, ethanol, ethylene, ethylene glycol, vinyl acetate, acrylic acid and acrylates, acrylonitrile, acetone, acetic acid, chloroprene, vinyl chloride, vinyl acetate, acrylonitrile, propylene, butadiene, butanes, isobutene, adipic acid, adiponitrile, benzene, toluene, xylene, phenol, styrene, phthalic acid, phthalic anhydride and their applications in chemical industry. | |
| | | **(Total Lecture Hours: 45)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| 3 | **Books Recommended** |
|---|---|
| 1 | Modern Petroleum Refining Processes, B. K. B. Rao, 4th Ed., Oxford & IBH Publishing Co. Pvt Ltd., New Delhi, 2002. |
| 2 | Fundamental of Petroleum Chemical Technology, P. Belov, 2nd Ed. Mir Publications, Moscow, 2009. |
| 3 | Industrial Chemistry, B.K. Sharma, Goel Publishing House, New Delhi, 2016 |
| 4 | Handbook of petroleum refining processes: R. A. Meyers, 4th Ed., McGraw Hill, New York, 2016 |
| 5 | Fundamentals of Petroleum and petrochemical Engineering, Uttam Rai Chaudhari, 1st Ed. CRC Press, Taylor & Francis group, Boca Raton, Florida, 2016 |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – IV (Ind. Chem.), Semester – VII<br>DYES, PAINTS AND PIGMENTS IN INDUSTRIES<br>IC452 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 03 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Explain about fundamental of paints and pigments. |
| CO2 | Discuss the difference between pigments and dyes. |
| CO3 | Explore various Inorganic, organic and special effect pigments. |
| CO4 | Explain paint manufacturing process. |
| CO5 | Able to formulate a coating for the given requirements. |

| 2. | Syllabus | |
|---|---|---|
| | **FUNDAMENTAL OF DYES** | **(07 Hours)** |
| | Introduction, relation between colour and chemical structure of dyes, classification, dyeing technology, principles of dyeing, standardization of textile dyes, laboratory dyeing techniques. | |
| | **TEXTILE DYEING OF AZO, SULFURE, INDIGO AND DISPERSE DYES** | **(08 Hours)** |
| | Introduction, chemistry, synthesis, general aspects, dyeing processes, fastness test and properties. | |
| | **FUNDAMENTAL OF PAINT** | **(07 Hours)** |
| | General Introduction of Paint Industry, definition of Paints, Varnishes and Lacquers, their constituents and functions. General classification of surface coatings, mechanism of film formation, sources and composition of oils, non–glyceride, components of oils, classification, extraction and refining of oils. | |
| | **PAINT MANUFACTURING** | **(08 Hours)** |
| | Rheology and rheological considerations (Pseudoplasticity, dilatatncy and thixotropy). Steps in paint manufacture- mixing, grinding, letdown, thinning, tinting (shade matching), straining, phenomenon of wetting, grinding and dispersion, important considerations in pigment dispersion. | |
| | **FUNDAMENTAL OF PIGMENTS** | **(07 Hours)** |
| | Concept of colour phenomena, classification of pigments, testing of pigments, oil absorption value, bulking value, sp. Gravity, refractive index, mass tone, reducing power, tinting strength etc. | |
| | **ORGANIC AND INORGANIC PIGMENTS** | **(08 Hours)** |
| | Natural organic pigments, comparison of organic pigments and inorganic pigments General method of preparation and classification of synthetic organic pigment.<br>Colour and white inorganic pigments such as titanium di-oxides, zinc oxide, iron oxide, lead chromate, silico chromates etc. | |
| | **(Total Contact Time: 45 Hours)** | |

| 4. | Books Recommended |
|---|---|

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| 1 | V. C. Maliha, M. A. Sikchi, Basics of Paint Technology- Part- I & II, First Edition, Publisher-Prakash C. Malshe, 2002. |
| 2 | J. Boxall, J. A. Von Fraunhofer, Paint Formulation: Principles and Practice, Publisher-Industrial Press Inc., U. S. ISBN-10 -0831110899, 1981. |
| 3 | T. C. Patton, Pigment handbook, Publisher-New York, Wiley, 1973. |
| 4 | G. R. Chatwal, *Synthetic Dyes*, 3rd edition, Himalaya Publishing House, 2007**.** |
| 5 | K. Hunger, Industrial Dyes: Chemistry, Properties, Applications, 3rd Revised Edition, Wiley-Vch Verlag GmbH & Co. KGaA, Weinheim. 2003. |


| **5.** | **Additional Reading Materials** |
|---|---|
| 1 | K. Venkatraman, *Chemistry of Synthetic Dyes*, Volume 1-5, 1st Edition, Academic Press, New York and London, 1972. |
| 2 | K. M. Shah, *"Handbook of Synthetic Dyes and Pigments"*, Volume 1-2, 2nd edition, Multi-tech Publishing Co., 1998. |
| 3 | H. A. Lubs, *The Chemistry of Synthetic Dyes and Pigments*, 4th Edition, Krieger Publishing Company, 1977. |
| 4 | W. M. Morgans, Outlines of Paint Technology, Publisher- Arnold, ISBN-10-085264079X, 1969. |
| 5 | S. Paul, Surface Coatings: Science and Technology, 2nd Edition, publisher-Wiley, 1996. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – IV (Ind. Chem.), Semester – VII | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **BIOMOLECULAR CHEMISTRY IN INDUSTRIAL APPLICATIONS IC453** | | **3** | **0** | **0** | **03** |

| **1.** | **Course Outcomes (COs):** **At the end of the course the students will be able to:** |
|---|---|
| CO1 | Understand the importance of building blocks of biomolecules. |
| CO2 | Classify the structure and functions of different bioorganic molecules. |
| CO3 | Understand the role of peptide, DNA in chemical industries. |
| CO4 | Identify various bioorthogonal reactions in green solvent. |
| CO5 | Apply molecular chemistry in industrial applications. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **PEPTIDE BIOENGINEERING** | **(10 Hours)** |
| | Amino acids, peptides, and proteins, peptide sequencing, peptide bond formation and coupling reagents-carbodiimides and phosphonium reagents, orthogonal protecting groups, solid-phase peptide synthesis: (Fmoc/Boc strategies), native peptide ligation; cyclic peptides, therapeutic peptides, peptide-based drug discovery and delivery, peptide-based biomaterials. Peptide in the food and cosmetic industries. | |
| | **FATTY ACIDS AND LIPIDS IN CHEMICAL INDUSTRY** | **(06 Hours)** |
| | Nomenclature and classification; saturated, monounsaturated, polyunsaturated fatty acid and essential fatty acids, industrial applications: cosmetics and personal care, lubricants and greases, food industry, pharmaceuticals, triacylglycerides and their properties, biological and pharmaceutical importance of lipids. | |
| | **CARBOHYDRATES** | **(09 Hours)** |
| | Structure, configuration, and conformation; common protecting groups and protecting group strategies; glycosylation: general concepts, various methods of glycoside bond formation; strategies in oligosaccharide synthesis; glycoconjugates: glycolipids and glycoproteins; carbohydrate-based drug discovery | |
| | **DNA-BASED TECHNOLOGIES IN CHEMICAL INDUSTRY** | **(10 Hours)** |
| | Structure of nitrogenous bases; structure and function of nucleotides; Watson and Crick model of DNA, solid phase synthesis of oligonucleotides, PCR, nucleic acid as drug targets, DNA-based drug screening like DNA-encoded chemical libraries (DECL), applications of DNA in materials science and engineering, biotechnology, and pharmaceuticals. | |
| | **BIORTHOGONAL CHEMISTRY** | **(10 Hours)** |
| | Click reaction; Copper(I)-catalyzed azide-alkyne cycloaddition (CuAAC), Strain-promoted azide-alkyne cycloaddition (SPAAC), Strain-promoted alkyne-nitrone cycloaddition (SPANC), Reactions of strained alkenes: Alkene and azide [3+2] cycloaddition, Alkene and tetrazine | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

| | |
|---|---|
| | inverse-demand Diels-Alder, Bioorthogonal chemistry and its applications in pharma industries. |
| | **(Total Lecture Hours: 45)** |

| **3.** | **Books Recommended** |
|---|---|
| 1 | Principles of Biochemistry, CBS, Lehninger, Nelson and Cox, WH Freeman, 7th edition 2017. |
| 2 | Biochemistry, Harper, McGraw-Hill, 29th edition. 2012. |
| 3 | A Handbook for DNA-Encoded Chemistry - Theory and Applications for Exploring Chemical Space and Drug Discovery, RA Goodnow, John Wiley & Sons Inc, 1st edition, 2014. |
| 4 | Bio-Organic Chemistry, P Sharma, R. K. Soni, Shree Publishers & Distributors, 2007. |
| 5 | Chemoselective and bioorthogonal ligation reactions: concepts and applications, W. Russ Algar, Philip Dawson, Igor L. Medintz, Wiley-VCH, 1st Edition, 2017. |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – IV (Ind. Chem.), Semester – VII | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **CHEMISTRY OF SUPRAMOLECULES**<br>**IC454** | | **3** | **0** | **0** | **03** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course, the students will be able to** |
|---|---|
| CO1 | Acquire basic and need of supramolecular chemistry. |
| CO2 | Study on thermodynamic and kinetic aspects of host-guest chemistry. |
| CO3 | Gain advance knowledge on artificial host molecules. |
| CO4 | Learn basic and applications of molecular self-assembly. |
| CO5 | Explore the application of supramolecular chemistry in device fabrication. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **FUNDAMENTALS OF SUPRAMOLECULAR CHEMISTRY** | **(09 Hours)** |
| | Molecules, super molecules and supramolecular Chemistry, non-covalent interactions, complementarity and cooperativity, supramolecular chemistry of life. | |
| | **HOST-GUEST CHEMISTRY** | **(14 Hours)** |
| | Host-guest complexation, Thermodynamics of host-guest complexation, Molecular recognition – factors involved, Molecular receptors/ Ionophores – design principles; Molecular receptors for cations, anions and neutral molecules, Crown ethers, cryptands, spherands, cyclodextrins, cucurbituril, and calixarenes, cavitands, molecular clips, clefts and tweezers, Threading of a linear molecule through a cyclic molecule, Creation of rotaxanes and catenanes. | |
| | **SELF-ASSEMBLY** | **(12 Hours)** |
| | Biological self-assembly, self-assembly in synthetic systems, self-assembling coordination compounds, capsules, helicates and molecular knots, Assembly and manipulation on the nanoscale, organic and inorganic nanomaterials, Functionalized nanoparticles and applications, Crystal nucleation and growth, understanding crystal structures, supramolecular gels, supramolecular polymers, Amphiphiles and their aggregation, Aggregation induced emission and quenching. | |
| | **MOLECULAR DEVICES** | **(10 Hours)** |
| | Supramolecular photochemistry and devices, chemosensors, Supramolecular drug delivery systems and catalysis, molecule-based electronics: Molecular wires, molecular switches, molecular logic, molecular rectifiers and molecular electronic devices. | |
| | | **(Total Contact Time: 45 Hours)** |

| **3.** | **Books Recommended** |
|---|---|
| 1 | J. W. Steed and J. L. Atwood, Supramolecular Chemistry, 3rd Edition, John Wiley, New York, 2022. |
| 2 | K. Ariga and T. Kunitake, Supramolecular chemistry-fundamentals and applications, 1st edition, Springer, Heidelberg, 2006. |
| 3 | J.W. Steed, D.R. Turner, K.J. Wallace, Core concepts in supramolecular chemistry and nanochemistry, 1st Edition, Wiley, USA, 2007. |
| 4 | H. Dodziuk, Introduction to supramolecular chemistry, 1st Edition, Springer (India) Pvt. Ltd., New |

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| | |
|---|---|
| | Delhi, 2002. |
| 5 | J. M. Lehn, Supramolecular chemistry, 1st Edition, Wiley-VCH, Germany, 1995. |



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# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech.-IV, (Ind. Chem.) Semester – VII<br>DRUG DESIGN AND DISCOVERY<br>IC455 | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 03 |

| 1. | Course Outcomes (COs):<br>At the end of the course, the students will be able to |
|---|---|
| CO1 | Recognise the drug metabolic pathways, adverse effect and therapeutic value of drugs. |
| CO2 | Gain knowledge of structural activity relationship of different class of drugs. |
| CO3 | Compute ligand and structure-based drug design. |
| CO4 | Learn the mechanism pathways of different class of medicinal compounds. |
| CO5 | Develop skill regarding the chemistry of drugs with respect to their pharmacological activity. |

| 2. | Syllabus | |
|---|---|---|
| | **INTRODUCTION TO DRUG DISCOVERY AND DEVELOPMENT** | **(07 Hours)** |
| | Process of drug discovery, Stages of drug discovery and development, Methods of Lead discovery, Random screening, Non-random screening, serendipitous drug discovery. Rational and modern drug discovery. | |
| | **DRUG-RECEPTOR INTERACTION** | **(07 Hours)** |
| | Types of receptors, Drug-Receptor interaction, agonist, antagonist, partial agonist, enzyme inhibition: competitive, non-competitive and allosteric inhibition. | |
| | **PHARMACOKINETICS AND PHARMACODYNAMICS** | **(08 Hours)** |
| | Drug adsorption, Distribution and disposition of drugs, excretion and elimination, uses of pharmacodynamics in drug development process, Enzyme stimulation, enzyme inhibition, membrane active drugs, drug metabolism, toxicology, dose and dose response, toxicity of metabolism. | |
| | **SAR AND QSAR** | **(07 Hours)** |
| | SAR of some important chemical scaffold including barbiturates, quinolone, antihistaminic, estrogen etc. Introduction to QSAR and its application in drug design. | |
| | **DRUG DESIGN APPROACHES** | **(08 Hours)** |
| | Ligand and structure based drug design. Understanding of virtual screening, Molecular Docking, Pharmacophore modelling, Protein data bank (PDB), overview of chemical databases like NCI, ZINC, PubChem etc. overview of different software used for drug design. | |
| | **SYNTHESIS, MECHANISMS AND THERAPEUTIC APPLICATIONS OF SOME IMPORTANT DRUGS** | **(08 Hours)** |
| | Classification of drugs, chemistry of sulfa drugs, antipyretics and analgesics, antibiotics, antituberculor, antifungal and anti-inflammatory drugs. Synthesis of selective drugs: Ciprofloxacin, Ibuprofen, Atenolol, Captopril, Diazepam, Chloroquine, Sulphanilamide, Miconazole, Biotin, Ethambutol, Ranitidine, and Omeprazole | |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| | |
|---|---|
| | **(Total Contact Hours: 45 Hours)** |

| **3.** | **Books Recommended** |
|---|---|
| 1 | M.E. Wolf, ed, The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry John Wiley and Sons, 8th Edition, New York 2021. |
| 2 | Y. C. Martin, *Quantitative Drug Design,* Dekker,2nd 8th Edition, New York 2010. |
| 3 | J.M. Beale, J.H. Block, Wilson and Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry, Lippincott Williams & Wilkins, 12th Edition, New York 2011. |
| 4 | T. L. Lemke, D. A. Williams, V. F. Roche, S. W. Zito, Foye's Principles of Medicinal Chemistry, Lippincott, Williams Wilkins, 7th Edition, Baltimore 2013. |
| 5 | G.L. Patrick, *An Introduction to Medicinal Chemistry*, Oxford University Press, 7th Edition, Oxford 2023. |

| **4.** | **Additional Reading Material** |
|---|---|
| 1 | A. Korolkovas, Essentials of Medicinal Chemistry, Wiley Interscience, 2nd Edition, New York, 2008. |
| 2 | H.J. Smith, H. Williams, Introduction to the principles of Drug Design, 4th Edition, Wright Boston 2005. |
| 3 | R. B. Silverman, The Organic Chemistry of Drug Design and Drug Action, Academic Press New York 3rd Edition, 2014. |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – IV (Ind. Chem.), Semester – VII | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **ELEMENTS OF TRANSPORT PHENOMENA**<br>**CH403** | | **3** | **1** | **0** | **04** |

| **1.** | **Course Outcomes (COs):**<br>**At the end of the course the students will be able to:** |
|---|---|
| CO1 | Describe basic of momentum, heat and mass transfer. |
| CO2 | Write shell balance equation for conservation of momentum, energy and mass; to obtain desired profiles for velocity temperature and concentration. |
| CO3 | Solved and analyze generalized macroscopic balance for conservation of momentum, energy and mass to obtain engineering quantities of interest. |
| CO4 | Solved and analyze appropriate equations of change to obtain desired profile for velocity temperature and concentration. |
| CO5 | Recognize and apply analogies amount momentum, heat and mass transfer. |
| CO6 | Explain interface transport. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **INTRODUCTION** | **(01 Hour)** |
| | **TRANSPORT BY MOLECULAR MOTION** | **(14 Hours)** |
| | Momentum transport by viscosity and momentum-flux. Energy transport by thermal conductivity and heat-flux. Mass transport by diffusivity and mass-flux. | |
| | **TRANSPORT IN ONE DIMENSION (SHELL BALANCE METHODS)** | **(17 Hours)** |
| | Shell momentum balances and velocity distributions. Shell energy balances and temperature distributions. Shell mass balances and concentration distributions. | |
| | **USE OF GENERAL TRANSPORT EQUATIONS** | **(06 Hours)** |
| | Equations of change and their use in momentum transport (isothermal). | |
| | **VELOCITY DISTRIBUTIONS IN TURBULENT FLOW** | **(01 Hour)** |
| | Comparisons of laminar and turbulent flows. Time-smoothed equations of incompressible fluids. | |
| | **INTERPHASE TRANSPORT IN ISOTHERMAL SYSTEMS** | **(02 Hours)** |
| | Friction factors for flow in tubes, flow around spheres, and packed columns. | |
| | **MACROSCOPIC BALANCES FOR ISOTHERMAL FLOW SYSTEMS** | **(02 Hours)** |
| | Macroscopic mass balance for steady and unsteady-state problems. | |
| | **INTRODUCTION TO EQUATIONS OF CHANGE FOR NON-ISOTHERMAL SYSTEMS AND MULTICOMPONENT SYSTEMS** | **(02 Hours)** |
| | Energy transport and mass transport. | |
| | **Tutorials will be based on the coverage of the above topics separately** | **(15 Hours)** |
| | **(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)** | |

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## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| **3.** | **Tutorial will be based on** |
|---|---|
| 1 | Various types of viscosity measurement instruments and their principles. |
| 2 | Viscosity estimation of gases. |
| 3 | Viscosity estimation of liquids. |
| 4 | Velocity distribution in different geometric systems. |
| 5 | Using equations of change for isothermal systems in different geometric systems to derive velocity distributions. |
| 6 | Friction factors in different geometric systems. |
| 7 | Macroscopic balances for isothermal flow systems in different geometric systems. |
| 8 | Thermal conductivity estimation of gases. |
| 9 | Temperature distribution in different geometric systems. |
| 10 | Diffusivity estimation for gases. |
| 11 | Mass transfer due to diffusion and concentration distribution. |

| **4.** | **Books Recommended** |
|---|---|
| 1 | Bird R.B., Stewart W.E. and Lightfoot E.N., “Transport Phenomena”, 1st and 2nd Eds., John Wiley & Sons, Singapore, 1960 & 2002. |
| 2 | Plawsky J.L., “Transport Phenomena Fundamentals”, Marcel Dekker, New York, 2001. |
| 3 | Thomson, W.J. “Introduction to Transport Phenomena” Pearson Education Asia, Singapore, 2000 |
| 4 | Geankoplis C.J., "Transport Processes and Separation Process Principles", 4th Ed., PHI, New Delhi, 2009. |
| 5 | Welty J.R., Wicks C.E., Wilson R.E. and Rorrer G., "Fundamentals of Momentum, Heat, and Mass Transfer", 4th Ed., Wiley India, 2007. |
| 6 | Brodkey R.S. and Hershey H.C., “Transport Phenomena: A Unified Approach” McGraw-Hill, 1989. |
| 7 | Slattery J.C., Sagis L., and Oh E.S., “Interfacial Transport Phenomena”, 2nd Ed., Springer, 2007 |

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry
**Institute Elective(s)**

| B. Tech. – III (Ind. Chem.), Semester – V | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **CHEMISTRY OF ENGINEERING MATERIALS**<br>**CY361** | | **3** | **0** | **0** | **03** |

| | |
|---|---|
| CO1 | Get an overall idea on the chemistry of engineering materials. |
| CO2 | Acquire a deep knowledge on various materials with their properties. |
| CO3 | Integrate key concepts regarding the classification, and properties of engineering materials. |
| CO4 | Explain and rationalize the engineering materials in terms of their applications in multidisciplinary science. |
| CO5 | Develop the skill to apply these materials in interdisciplinary fields of engineering. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **FUELS** | **(10 Hours)** |
| | Solid fuels, analysis of coal, pulverized coal, carbonization, determination of calorific value, Bomb calorimeter, furnace designs, liquid fuels, fractionation of petroleum, cracking, refining, knocking in petro engines, octane rating, diesel engine, knocking, cetane number, alternate fuels. Gaseous fuels, composition of natural gas, coal gas, producer gas, water gas and LPG, manufacture, properties and application, principle of Flue gas analysis by Orsat's method. | |
| | **EXPLOSIVES AND PROPELLANT** | **(08 Hours)** |
| | Explosives: Introduction, classification of explosives, primary and secondary explosive, properties, manufacture of important Explosives; TNT, RDX, nitro-glycerine, HMX, PETN Propellant: Introduction, classifications of propellants, uses, rocket propellants. | |
| | **LUBRICANTS** | **(08 Hours)** |
| | Introduction, classification and properties, mechanism of lubrication, properties and testing, additives, Lubricating oils, emulsions and gels, solid lubricants, silicon lubricants, Bio-lubricants: Raw materials, chemical modifications and environmental benefits. | |
| | **ADHESIVES AND PAINTS** | **(09 Hours)** |
| | Adhesives, Theories of adhesive bond, adhesiveness testing. Paints: Constituents and their functions, emulsion paints, special paints: composition and applications of luminescent paints, water repellent paints, heat resistant paints, fire retardant paints and acid resistant paints. | |
| | **CEMENT, CERAMICS AND REFRACTORIES** | **(10 Hours)** |
| | **Cement:** Chemical composition, setting and hardening of cement, hydration of cement, manufacture of process, quick setting cement, high alumina cement, sorel cement, white Portland cement and water proof cement.<br>**Ceramic:** Introduction, important clays and feldspar. Ceramics-types, uses and manufacture. High technology ceramics and their applications.<br>**Refractories:** Introduction, classification, manufacture of refractories, insulating refractories, requirements of a refractory. | |
| | | **(Total Contact Time: 45 Hours)** |

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| **4.** | **Books Recommended** |
|---|---|
| 1 | H. D. Gesser, Applied Chemistry: A text book for Engineers and Technologists, Plenum Publishers, London, 2002. |
| 2 | J. C. Kuriacose, J. Rajaram, Chemistry in Engineering and Technology, volumes 1 & 2, Tata McGraw Hill, 1996. |
| 3 | P. C. Jain, Monica, Engineering Chemistry, Dhanpat Rai Publishing Co., New Delhi, 2002. |
| 4 | S. Chawla, A text book of Engineering Chemistry, twenty third edition, Dhanpat Rai Publishing Co., New Delhi, 2005. |
| 5 | B. K. Sharma, Industrial Chemistry, Goel Publishing House, Meerut, 1989. |

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# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
## Department of Chemistry
## B.Tech. in Industrial Chemistry

| B. Tech. – III (Ind. Chem.), Semester – VI | Scheme | L | T | P | Credit |
|---|---|---|---|---|---|
| **ANALYTICAL TECHNIQUES FOR MATERIAL CHARACTERIZATION CY362** | | **3** | **0** | **0** | **03** |

| | |
|---|---|
| CO1 | Acquire knowledge about the widely used analytical techniques. |
| CO2 | Understand basic concepts of Raman and electron spectroscopic techniques and their applications in characterization of materials. |
| CO3 | Learn basics and instrumentation of surface analytical techniques. |
| CO4 | Know the instruments of electron spectroscopy and its applications for quantitative analysis. |
| CO5 | Understand concepts of thermal methods for characterization of various materials. |

| **2.** | **Syllabus** | |
|---|---|---|
| | **RAMAN SPECTROSCOPY** | **(09 Hours)** |
| | Introduction – principle – characteristic properties of Raman lines – difference between Raman spectra and Infra-red spectra – mechanism of Raman effect – instrumentation – intensity of Raman peaks – applications. | |
| | **ELECTRON SPECTROSCOPY** | **(12 Hours)** |
| | Introduction, Instrumentation and applications of Electron spectroscopy (ESCA and Auger), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning tunnelling microscopy (STM) and Atomic force microscopy (AFM). | |
| | **SURFACE ANALYSIS** | **(09 Hours)** |
| | Auger electron spectroscopy - introduction – Auger process – secondary electron energy distribution – instrumentation – data interpretation and surface analysis – Auger yield – calculation of surface composition – sensitivity limit – trace analysis. | |
| | **THERMAL METHODS** | **(15 Hours)** |
| | Different methods of thermal analysis, Thermo gravimetric methods of analysis: Instrumentation, thermogram and information from thermogram, factors affecting thermogram, applications TGA for quantitative analysis. Differential Thermal Analysis (DTA): Instrumentation, general principles, differential thermogram, DT and TG curve together, Applications. Differential Scanning Calorimetry (DSC): Principle, Instrumentation, and Applications, thermometric titrations, Evolved gas analysis. | |
| | **(Total Contact Time: 45 Hours)** | |

| **3.** | **Books Recommended** |
|---|---|
| 1 | J. R. Lakowicz, 'Principles of Fluorescence Spectroscopy', Springer 4th Edition. 2006. |
| 2 | E. Smith, G. Dent, Modern Raman Spectroscopy A Practical Approach 2Nd Edition, Jhon & Wiley Sons Ltd., 2019. |
| 3 | Stefan Hüfner, Photoelectron Spectroscopy Principles and Applications, Springer, 2003 |
| 4 | Skoog, Holler, Nieman, Principles of Instrumental Analysis, 5th ed., Harcourt College Publishers, 1998 |
| 5 | Galen Ewing, Instrumental Methods & Chemical Analysis, 5th ed., McGraw-Hill Publishing Company Ltd., 1985. |

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