

**Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot
(Autonomous)
Affiliated to Saurashtra University, Rajkot
Department of Industrial Chemistry
B. Sc. INDUSTRIAL CHEMISTRY**

OBJECTIVES OF THE PROGRAMME

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

- To uphold the values embodied in the institute's vision and mission.
- To imparting knowledge of both pure science and engineering to support lifelong learning while maintaining high professional ethical standards
- To work in a team using common tools and environments to achieve project/organizational objectives.
- To pursue life-long learning as a means of enhancing the knowledge base and skills necessary to contribute to the improvement of their profession and community ensuring essential knowledge to pursue M.Sc. & thereafter Ph.D. degree in Industrial Chemistry in progression.

SCHEME OF INSTRUCTION AND EXAMINATIONS
For Students Admitted From A.Y. 2016-17 & Onwards

Semester-I							
Course Code	Course	Hrs. of Instruction/ week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Total	
Part-I							
16ULCEN01	Functional English-I	3	3	40	60	100	3
Part-II							
16UICCC01	Core-1 Industrial Instrumentations	4	3	30	70	100	4
16UICCC02	Core-2 Renewable & Non-Renewable Sources	4	3	30	70	100	4
16UICDA01	DSE Allied-1 Chemistry-I	3	3	30	70	100	3
16UICCC03	Core Practical-1 Industrial Instrumentations Practical	6	3	20	30	50	3
16UICCC04	Core Practical-2 Renewable & Non-Renewable Sources Practical	6	3	20	30	50	3
16UICDA02	DSE Allied Practical-1 Chemistry-I Practical	2	3	20	30	50	1
		28				550	21
PART-III							
	AECC-I Environmental Science	1	-	-	-	-	-
	SEC-I Value Education-I	1	-	Remarks			1
		30					22

Semester-II							
Course Code	Course	Hrs. of Instruction/week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Total	
Part-I							
16ULCEN02	Functional English-II	3	3	40	60	100	3
Part-II							
16UICCC05	Core-3 Surface Chemistry	4	3	30	70	100	4
16UICCC06	Core-4 Polymer Chemistry & Technology	4	3	30	70	100	4
16UICDA03	DSE Allied-2 Chemistry-II	3	3	30	70	100	3
16UICCC07	Core Practical-3 Surface Chemistry Practical	6	3	20	30	50	3
16UICCC08	Core Practical-4 Polymer Chemistry & Technology Practical	6	3	20	30	50	3
16UICDA04	DSE Allied Practical-2 Chemistry-II Practical	2	3	20	30	50	1
		28				550	21
PART-III							
	AECC-I Environmental Science	1	-	Remarks			2
	SEC-I Value Education-II	1	-	Remarks			1
		30					24

Semester-III							
Course Code	Title	Hrs Instruction Per Week	Exam Duration Hrs	Maximum Marks			Credits
				CIE	SEE	Total	
Part-I							
16ULCEN03	Advanced English Language-I	3	3	40	60	100	3
Part-II							
16UICCC09	Core-5 Unit Operations	4	3	30	70	100	4
16UICCC10	Core-6 Dyes & Dyeing, Pigments & Paints	4	3	30	70	100	4
16UICCC11	Core-7 Material Science	3	3	30	70	100	3
16UICDA05	DSE Allied-3 Physics-I	3	3	30	70	100	3
16UICCC12	Core Practical-5 Unit Operations Practical	4	3	20	30	50	2
16UICCC13	Core Practical-6 Dyes & Dyeing, Pigments & Paints Practical	6	3	20	30	50	3
16UICDA06	DSE Allied Practical-3 Physics-I Practical	2	3	20	30	50	1
		29		650			23

Semester-IV							
Course Code	Title	Hrs Instruction Per Week	Exam Duration Hrs	Maximum Marks			Credits
				CIE	SEE	Total	
Part-I							
16ULCEN04	Advanced English Language-II	3	3	40	60	100	3
Part-II							
16UICCC14	Core-8 Unit Processes	3	3	30	70	100	3
16UICCC15	Core-9 Analytical Chemical Technique	3	3	30	70	100	3
16UICCC16	Core-10 Mass & Energy Balance	3	3	30	70	100	3
16UICDA07	DSE Allied-4 Physics-II	3	3	30	70	100	3
16UICCC17	Core Practical-7 Unit Processes Practical	4	3	20	30	50	2
16UICCC18	Core Practical-8 Analytical Chemical Technique Practical	6	3	20	30	50	3
16UICDA08	DSE Allied Practical-4 Physics-II Practical	2	3	20	30	50	1
		27				650	21

Semester-V							
Course Code	Title	Hrs Instruction Per Week	Exam Duration Hrs	Maximum Marks			Credits
				CIE	SEE	Total	
Part-II							
16UICCC19	Core-11 Principles of Chemical Engineering-I	3	3	30	70	100	3
16UICCC20	Core-12 Heavy Chemicals	3	3	30	70	100	3
16UICCC21	Core-13 Industrial Utilities (Self-Study)	1	3	30	70	100	4
16UICDC01/ 16UICDC02/ 16UICDC03	DSE Core Elective-1 Petroleum & Petrochemicals / Industrial Safety / Cement & Ceramic Industries	4	3	30	70	100	4
16UICCC22	Core Practical-9 Principles of Chemical Engineering Practical	4	3	20	30	50	2
16UICCC23	Core Practical-10 Heavy Chemicals Practical	4	3	20	30	50	2
16UICDC04/ 16UICDC05/ 16UICDC06	DSE Core Elective Practical-1 Petroleum Analysis Practical / Industrial Safety Practical / Cement & Ceramic Industries Practical	4	3	20	30	50	2
16UICCC24	Core-14 Computer Based Test	-	3	100	-	100	1
16UICGE01	Generic Elective-I	2	-	100	-	100	2
	Industrial Training & Project Report/ Survey/ Review Writing/ Seminar	2	-	Evaluation in Sem- VI			-
		27		750			23

Semester-VI							
Course Code	Title	Hrs Instruction Per Week	Exam Duration Hrs	Maximum Marks			Credits
				CIE	SEE	Total	
Part-II							
16UICCC25	Core-15 Principles of Chemical Engineering-II	3	3	30	70	100	3
16UICCC26	Core-16 Fine Chemicals	3	3	30	70	100	3
16UICCC27	Core-17 Bulk Drugs, intermediates & API	3	3	30	70	100	3
16UICDC07/ 16UICDC08/ 16UICDC09	DSE Core Elective-2 Industrial Management / Chemistry of Natural Products / Surface Coating Techniques	4	3	30	70	100	4
16UICCC28	Core Practical-11 Fine Chemicals Practical	4	3	20	30	50	2
16UICCC29	Core Practical-12 Bulk Drugs, Intermediates & API Practical	4	3	20	30	50	2
16UICDC10/ 16UICDC11/ 16UICDC12	DSE Core Elective Practical-2 Industrial Management Practical / Chemistry of Natural Products practical / Surface Coating Techniques Practical	4	3	20	30	50	2
16UICGE02	Generic Elective-II	2	-	100	-	100	2
16UICCC30	Industrial Training & Project Report/ Survey/ Review Writing/ Seminar	2	-	40	60	100	2
		29				750	23
						Total Marks	3900

PART III

Course Code	Semester	Particulars	Hrs of instruction/week	No. of Courses	Credit/Course	Total Credits
Ability Enhancement Compulsory Course (AECC)						
As per common list	I & II	AECC-I Environment Science	1	1	2	2
	IV & V	AECC-II Communication Skill/Soft Skills	2	2	1	2
					Sub Total	4
Skill Enhancement Course (SEC)						
As per common list	I	SEC-I Value Education-I	1	1	1	1
	II	SEC-I Value Education-II	1	1	1	1
	Any Semester between II - V	SEC-II *Co-Curricular Course	> 40 hours in total	1	1	1
	Any Semester between II - V	SEC-III **Value Added Courses	40 hours in total	1	1	1
					Sub Total	4
					Grand Total	8

* **Co-Curricular Courses** – Option to students to choose 1 from a list of courses offered by the college such as Add on Courses, Gandhian studies Certificate Course, Women Studies Course, etc.

****Value Added Courses**- option to student to choose at least 1 from a list of courses offered from UG departments.

**B. Sc. INDUSTRIAL CHEMISTRY
TOTAL MARKS & CREDIT DISTRIBUTION**

Sr.No.	Part	Total Marks	Total Credits
1.	Part-I : Language Course	400	12
2.	Part-II : Core, DSE-Allied, DSE Core, GE	3500	120
3.	Part-III : AECC-I & II and SEC-I, II & III	Remarks	08
Total		3900	140

DISTRIBUTION OF COURSES

PART-I: LANGUAGE COURSE

The following courses offered in First to Fourth Semester are compulsory.

Sr. No	Semester	Course Code	Course
1.	I	16ULCEN01	Functional English-I
2.	II	16ULCEN02	Functional English-II
3.	III	16ULCEN03	Advanced English Language-I
4.	IV	16ULCEN04	Advanced English Language-II

**PART-II: CORE, DSE CORE, DSE-ALLIED, GE
CORE COURSES [Theory]**

Sr. No.	Semester	Course Code	COURSE
1.	I	16UICCC01	Industrial Instrumentations
2.		16UICCC02	Renewable & Non-Renewable Sources
3.	II	16UICCC05	Surface Chemistry
4.		16UICCC06	Polymer Chemistry & Technology
5.	III	16UICCC09	Unit Operations
6.		16UICCC10	Dyes & Dyeing, Pigments & Paints
7.		16UICCC11	Material Science
8.	IV	16UICCC14	Unit Processes
9.		16UICCC15	Analytical Chemical Technique
10.		16UICCC16	Mass & Energy Balance
11.	V	16UICCC19	Principles of Chemical Engineering-I
12.		16UICCC20	Heavy Chemicals
13.		16UICCC21	Industrial Utilities (Self-Study)
14.		16UICCC24	Computer Based Test (MCQ based on Fundamentals & Principles of Core Subjects From Semester I to Semester V)
15.	VI	16UICCC25	Principles of Chemical Engineering-II
16.		16UICCC26	Fine Chemicals
17.		16UICCC27	Bulk Drugs, Intermediates & API

CORE COURSES [Practical]

Sr. No.	Semester	Course Code	COURSE
1.	I	16UICCC03	Industrial Instrumentations
2.		16UICCC04	Renewable & Non-Renewable Sources
3.	II	16UICCC07	Surface Chemistry
4.		16UICCC08	Polymer Chemistry & Technology
5.	III	16UICCC12	Unit Operations
6.		16UICCC13	Dyes & Dyeing, Pigments & Paints
7.	IV	16UICCC17	Unit Processes
8.		16UICCC18	Analytical Chemical Technique
9.	V	16UICCC22	Heavy Chemicals
10.		16UICCC23	Principles of Chemical Engineering
11.	VI	16UICCC28	Fine Chemicals
12.		16UICCC29	Bulk Drugs, Intermediates & API

OTHER CORE COURSES

Sr. No	Semester	Course Code	Course
1.	V to VI	16UICCC30	Industrial Training & Project Report/ Survey/ Review Writing/ Seminar

DSE ALLIED COURSE

The DSE allied COURSE given in first to fourth semester which is compulsory.

Sr.No.	Semester	Course Code	COURSE
1.	I	16UICDA01	Chemistry-I
2.	II	16UICDA03	Chemistry-II
3.	III	16UICDA05	Physics-I
4.	IV	16UICDA07	Physics-II

DSE ALLIED COURSE [Practical]

The DSE allied COURSE Practical given in first to fourth semester is compulsory.

Sr.No.	Semester	Course Code	COURSE
1.	I	16UICDA02	Chemistry-I
2.	II	16UICDA04	Chemistry-II
3.	III	16UICDA06	Physics-I
4.	IV	16UICDA08	Physics-II

DSE CORE COURSE [Theory & Practical]

Students are required to opt for any one of the courses offered in V & VI semesters respectively.

Sr. No	Semester	Theory		Practical	
		Course Code	Course	Course Code	Course
1	V	16UICDC01	Petroleum & Petrochemicals	16UICDC04	Petroleum Analysis
		16UICDC02	Industrial Safety	16UICDC05	Industrial Safety
		16UICDC03	Cement & Ceramic Industries	16UICDC06	Cement & Ceramic Industries
2	VI	16UICDC07	Industrial Management	16UICDC10	Industrial Management
		16UICDC08	Chemistry of Natural Products	16UICDC11	Chemistry of Natural Products
		16UICDC09	Surface Coating Techniques	16UICDC12	Surface Coating Techniques

GENERIC ELECTIVE

Sr. No	Semester	Course Code	Course
1.	V		Any one course from list of courses offered across UG departments
2	VI		

PART III: AECC and SEC

Course Code	Semester	Particulars	Hrs of instruction/week	No. of Courses	Credit/Course	Total Credits
Ability Enhancement Compulsory Course (AECC)						
As per common list	I & II	AECC-I Environment Science	1	1	2	2
	IV & V	AECC-II Communication Skill/Soft Skills	2	2	1	2
					Sub Total	4
Skill Enhancement Course (SEC)						
As per common list	I	SEC-I Value Education-I	1	1	1	1
	II	SEC-I Value Education-II	1	1	1	1
	Any Semester between II - V	SEC-II *Co-Curricular Course	> 40 hours in total	1	1	1
	Any Semester between II - V	SEC-III **Value Added Courses	40 hours in total	1	1	1
					Sub Total	4
					Grand Total	8

* **Co-Curricular Courses** – Option to students to choose 1 from a list of courses offered by the college such as Add on Courses, Gandhian studies Certificate Course, Women Studies Course, etc.

****Value Added Courses**- option to student to choose at least 1 from a list of courses offered from UG departments.

- Courses offered by Industrial chemistry department to UG students of other department.

Sr. No.	Sem	Course Code	Course Name
1	V	16UICGE01	Generic Elective-I
2	VI	16UICGE02	Generic Elective-II

**B.SC. INDUSTRIAL CHEMISTRY
SEMESTER-I**

16UICCC01	Core-1 Industrial Instrumentations	04 hrs/wk	04 Credit
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Objectives:

1. Compare direct and indirect methods of measurement of industrial parameters
2. Explain role of Industrial instrumentation including Temperature, Pressure, Viscosity, Liquid level and Density
3. Calibration of the instruments applied for Temperature, Pressure, Viscosity, Liquid level and Density measurement
4. Knowledge of techniques used for the measurement of industrial parameters.
5. Discuss conversion of units for measurement of industrial parameters.

Unit-I: Basics of industrial Instrumentation (09 hrs)

- An introduction to Instrumental methods, Major steps in solving an analytical problem, Basics functions of instruments
- Measurement, Signals and Data: Signal-to-Noise ratio, Sensitivity and Detection limit, Sources of
- Noise, Accuracy and Instrument calibration, the meaning of measurement
- Basics of Industrial Instrumentation:
- Introduction, Types of measurement: Direct measurement, indirect measurement, Functions of measuring instruments, Elements of instrument, Classification of measuring instrument,
 - According to operation
 - According to the source of power
 - According to the arrangement
 - Characteristics of an instrument: Static characteristics and Dynamic characteristics

Unit-II: Viscosity (09 hrs)

- Introduction
- Principle, construction and working of following Viscosity measurement devices:
 1. Orifice type viscometer
 2. Falling sphere viscometer
 3. Rotational viscometer
 4. Brookfield viscometer
 5. Saybolt viscometer
 6. Redwood viscometer

Unit-III: Temperature (10 hrs)

- Introduction, various Temperature scales
- Construction of the element of Temperature measuring elements:
- Thermometer bulb and well, Thermometer capillary and armor, Receiving element
- (Pressure spring), Recording (Indicating) element

- Principle, construction and working of following Temperature measuring instruments:
 1. Volume gas thermometer
 2. Glass thermometer
 3. Bimetallic thermometer
 4. Pressure spring thermometer
 5. Vapour actuated thermometer
 6. Pneumatic balance pressure thermometer
 7. Resistance thermometer
 8. Industrial resistance thermometer bulbs (RT bulbs)
- Introduction, Laws of radiation
- Principle, construction and working of following Radiation Temperature measuring instruments:
 1. Radiation pyrometers
 2. Vacuum thermocouple
 3. Balometer
 4. Photoelectric pyrometer
 5. Optical pyrometer

Unit-IV: Pressure

(10 hrs)

- Introduction,
- Principle, construction and working of following Pressure measurement devices:
- Liquid column manometer:
 - U-tube manometer
 - Inclined manometer
 - Well type manometer
 - Ring type manometer
 1. Barometer
 2. Bourdon gauge
 3. Bellows gauge
 4. Diaphragm gauge
 5. McLeod gauge
 6. Thermal conductivity gauge
 7. Pirani gauge
 8. Thermocouple gauge
 9. Ionization gauge
- **Measuring pressure in corrosive fluids:**
 1. Single coil siphon
 2. Diaphragm seal
 3. Liquid seal
 4. Purge system

Unit-V: Liquid level and Density

(10 hrs)

- Introduction, Methods of liquid level measurement: Direct method and indirect method
- Principle, construction and working of following Liquid level measurement devices:
- Direct methods :Hook type level indicator, Sight glass, Float type level indicator

- Indirect methods : Pressure gauge method, Bubbler system, Diaphragm box system,-Air-trap system

Level measurement in pressure vessels:

- Radiation level indicator
- Ultrasonic method for level measurement

Density measurement:

- Introduction
- Principle, construction and working of following Density measurement devices:
 1. Liquid level method of measuring specific gravity or density,
 2. Displacement meter for measuring specific gravity or density,
 3. Hydrometer

Text Books:

1. D.P. Eckman, (2014), Industrial Instrumentation, John-Wiley's and sons.
2. W. Merritt and D. Settle, 7th Edition, Instrumental methods of Analysis, CBS Publishers

Reference Books:

1. W.G. Andrews, Applied Instrumentation in process industries, volume 1, 2 and 3, Gulf Publication
2. S. Borer Instrumentation and Control for the process industries Elsevier applied science publisher

16UICCC02	Core-2 Renewable & Non-Renewable Sources	04 hrs/wk	04 Credits
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Objectives:

1. Determine Industrial fuels its specific utilization.
2. Enhance the skill of industrial fuel production and their processes.
3. Study renewable natural resources and their production processes.
4. Determine utilization of natural resources.

Unit-I: Liquid Fuel –Petroleum (10 hrs)

- Introduction to petroleum, Origin of Petroleum, Petroleum Production, Composition of Petroleum
- Classification of Petroleum, Nature of Indian Crude
- Important petroleum products including gasoline, kerosene, ATF, diesel, fuel oils, lubricants
- Storage and handling of liquid fuels.
- Liquid fuels from sources other than petroleum including coal tar.
- Storage and handling of liquid fuels including ring main system.

Unit-II: Processing of liquid fuels (10 hrs)

- Petroleum processing, physical separation includes three stage distillation process, breakdown processes including fluidized bed catalytic cracking & Dubb's process
- Rebuilding processes including Polymerization, alkylation, isomerization & hydrogenation.
- Purification processes of petroleum products including Desulfurization, neutralization, solvent extraction, deasphalting, dewaxing & deoiling
- Petroleum refining in India, flow sheet of petroleum refinery

Unit-III: Solid Fuel -Coal (09 hrs)

- Definitions, units and measures, origin of coal, rank of coal including peat, lignite, bituminous, anthracite, graphite, Natural coke and (jhama)/SLV.
- Ultimate and proximate analysis of coal, GCV, NCV, Preparation.
- Storage and handling of coal, coal carbonization including beehive oven, vertical and horizontal retorts including continuous and intermittent type; briquetting of coal.
- Liquefaction and gasification of solid fuels for manufacturing coal tar, coal gas, producers gas, purification of coal gas.

Unit-IV: Gaseous Fuels: Natural & Synthetic (10 hrs)

- Natural gas, composition of natural gas, handling and storage of natural gas,
- natural gas production process, units and measures of Natural gas, CNG, PNG, LPG their production,
- Types of combustion processes (including surface combustion, flameless combustion, submerged combustion, explosion flame, pulsating combustion, slow combustion, combustion of grate), combustion appliances (including gas burners, oil burners, solid burner)

Unit-V: Renewable Natural Source**(09 hrs)**

- Cellulose, its preparation and properties, Nitrocellulose, Cellobiose, Celluloid
- Artificial silk, Acetate Silk, Cuprammonium process (Cupra Silk), Viscose silk (Rayon).
- Paper, Caustic soda process and Sulphite process
- Starch, Manufacturing of starch from corn, Properties & uses of Starch, Dextrin, Glycogen, Inulin, Raw starch, Tapioca starch, Iodized starch.
- Alcohols, Methyl alcohol, Ethyl alcohol, Denatured alcohol, Special solvent alcohol, Propyl alcohol, Butyl alcohol, Carboxy Methyl Cellulose(CMC)

Text Books:

1. B. K. Sharma, (2014), *Industrial Chemistry*, Krishna Publication ISBN: 978-81-8283-829-1.
2. Samir Sarkar, (2010), *Fuel & Combustion* (3Rd Edition), Orient BlackSwan, 1974. ISBN, 8173716692, 9788173716690. Length, 482 pages.

Reference Books:

1. E.J. Hoffman, (2014), *Coal conversions*, Theenergon co. Lavamic, Wyoming USA.
2. Hall A.G. (2012), *Cotton – Cellulose: It's Chemistry & Technology*.

16UICCC03	Core Practical-1 Industrial Instrumentations Practical	06 hrs/wk	03 Credits
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Objectives:

1. Compare direct and indirect methods of measurement of industrial parameters
2. Explain role of Industrial instrumentation including Temperature, Pressure, Viscosity, Liquid level and Density
3. Calibration of the instruments applied for Temperature, Pressure, Viscosity, Liquid level and Density measurement
4. Knowledge of techniques used for the measurement of industrial parameters.
5. Discuss conversion of units for measurement of industrial parameters.

List of Experiments:

1. Determination of pressure using Bourdon's pressure gauge.
2. Determination of blood pressure using Blood pressure measurement unit.
3. To measure pressure of a gas in pipeline using mercury U tube manometer.
4. To determine Viscosity of liquid, flow time and concentration of unknown solution.
5. To determine Viscosity, flow time and concentration of liquid mixture (Glycerol & Water) by Ostwald's viscometer.
6. To determine absolute viscosity of 10%, 5%, 2.5% glycerine solution and concentration of unknown solution by Ostwald's viscometer.
7. To determine relative viscosity of pure liquid A, B, C and D by Ostwald's viscometer.
8. Determination of Viscosity of unknown substance using Brookfield digital viscometer.
9. To calibrate the given thermometer with solid substance.
10. To measure relative body temperature using body temperature measurement unit.
11. To measure relative temperature using contact temperature meter.
12. To measure relative Infrared temperature using IR temperature measurement gun.
13. To measure the flow rate and determine co-efficient of discharge flow of water flowing through a pipeline using venturimeter.
14. To measure the flow rate and determine co-efficient of discharge flow of water flowing through a pipeline using orificemeter
15. To measure the flow rate of water in a pipeline using Rotameter.

16UICCC04	Core Practical-2 Renewable & Non-Renewable Sources Practical	06 hrs/wk	03 Credits
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Objectives:

1. Determine Industrial fuels its specific utilization.
2. Enhance the skill of industrial fuel production and their processes.
3. Study renewable natural resources and their production processes.
4. Determine utilization of natural resources.

List of Experiments:

1. Study the distillation techniques of petroleum mixture (solid and liquid) by simple distillation.
2. Study the distillation techniques of petroleum mixture by fractional distillation.
3. Analyze moisture content in petroleum products by dean & stark method.
4. Analyze moisture content of petroleum products by Karl Fischer automatic method.
5. Analyze moisture content of petroleum products by Karl Fischer manual method.
6. Synthesize short chain petroleum products from tar.
7. Analyze moisture content of anthracite coal.
8. Analyze moisture content of peat.
9. Analyze moisture content of lignite.
10. Prepare paper from pulp by caustic soda process.
11. Prepare paper from pulp by CS₂ process.
12. Prepare cellulose acetate from raw cellulose.

**B.SC. INDUSTRIAL CHEMISTRY
SEMESTER II**

16UICCC05	Core-3 Surface Chemistry	04 hrs/wk	04 Credits
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Objectives:

1. Evaluate and describe colloidal Nano-technological and chemical systems, processes and products
2. Use different theories to calculate surface and interfaces tensions and use this to estimate e.g. wetting and other system characteristics
3. Describe the conditions for stability of colloidal systems and discuss and compare different mechanisms for stabilization
4. Describe mechanisms for stabilization of emulsions and foam, and design emulsions and foam.

Unit-I: Adsorption

(09 hrs)

- Adsorbate, Adsorbent, Adsorption of gases by solid,
- Physical & Chemical adsorption, Factors affecting adsorption, Adsorption isotherms, Freundlich isotherm, Langmuir Adsorption,
- BET theory including calculations, Adsorption of solute from solution,
- Experimental determination of gas adsorptions including volumetric method & gravimetric method, Mechanical adsorption & its types,
- Formation of surface films, Applications of adsorption Application of Ion exchange adsorption.
- Surface active agents and their classification, concept of micelles, critical micelle concentration (CMC).

Unit-II: Corrosion-I

(09 hrs)

- Introduction, Rusting, Causes of corrosion,
- Classification of corrosion, Dry corrosion or direct chemical corrosion, Wet corrosion or electrochemical corrosion, Liquid metal corrosion, Oxidation corrosion,
- Pilling-Bedworth rule, Corrosion by other gases, Hydrogen embrittlement, Decarburation,
- Electrochemical series, Galvanic series, Factors influencing corrosion.
- Mechanism of wet corrosion by Evolution of H₂ gas, Absorption of O₂ gas.
- Various types of corrosion, Galvanic corrosion, Concentration cell corrosion, Differential cell corrosion, Atmospheric corrosion, Stray current corrosion, Underground or soil corrosion, Microbiological corrosion, Uniform corrosion, Pitting corrosion, Stress corrosion, Erosion corrosion, Fretting corrosion.

Unit-III : Corrosion-II

(10 hrs)

- Cavitation corrosion, Crevice corrosion
- Corrosion control and protection techniques, Proper designing of materials.
- Use of highly pure metals, Use of metal alloys, Use of special heat treatments, Cathodic protection, Super imposition of impressed current, Sacrificial anode, Use of inhibitors, Modifying the environment.

- Use of protective surface coatings. Metallic coatings, Anodic coating, Cathodic coating, Hot dipping, Metal spraying, Electroplating, Galvanizing, Cladding, Vapour plating, Cementation, Inorganic coating, Phosphate coating, Chromate coating, Chemical oxide coating, Vitreous coating, Organic coating, Paints, Varnishes, Lacquers, Shellac, Emulsion paints, Enamels, Organic linings (rubber and plastics), Distempers, Cement paints.
- Inhibition efficiency and factors influencing inhibition efficiency, measurement of inhibition efficiency.

Unit-IV: Catalysis

(10 hrs)

- Introduction of homogeneous & heterogeneous, positive & negative catalysis, Characteristics of catalytic reaction, Promoters, Catalytic poisoning, Autocatalysis, Activation energy & catalysis
- Theories of catalysis with mechanism (intermediate compound formation & adsorption theories), Acid-Base catalysis, Enzyme catalysis, Mechanisms, Characteristics of enzyme catalysis, Some industrial importance of catalytic process.

Unit-V: Colloidal Solution

(10 hrs)

- Colloidal dispersion introduction & its classification, Lyophilic and Lyophobic colloids, Colloidal solution preparation and purification, Optical properties of sols, Kinetic properties of sols, Sedimentation of suspension, Electrophoresis, Electro-osmosis, Stability Of suspension, Precipitation of sols
- Emulsions, Gels, Surfactants, Hydrophile - Lipophile Balance. Determination of CMC by conductivity and surface tension methods; factors affecting CMC

Text Books:

1. Puri L.R. and Sharma B.R.,(1998),*Physical Chemistry*, NewDelhi: Chand S. & Co.
2. B.R. and Boyd L.L., 1999. *Organic Chemistry*. New Delhi: ELBS.

Reference Books:

1. J.J. Bikerman, 1972. *Surface Chemistry*. New York: Academicpress
2. A.W. Adamson, 1960. *Physical Chemistry of Surfaces*. New York: Inter science publishers Inc.
3. B.K. Sharma, 2001. *Industrial Chemistry*. New Delhi: Chand S. and Co.

16UICCC06	Core-4 Polymer Chemistry & Technology	04 hrs/wk	04 Credits
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Objectives:

1. Determine different polymers their properties and access them according to their industrial applications.
2. Study different polymerization techniques & their mechanisms.
3. Know Industrial polymer processing & their engineering aspects.

Unit-I: Introduction (09 hrs)

- Polymer, Oligomer, Macromolecules,
- Classification of polymer, Sources of polymer, Monomers, Functionality concept, Concept of Cross linking.
- Molecular weight and molecular weight distribution number, Weight and viscosity average molecular weight of polymers. Method of determining molecular weight,
- Practical significance of molecular weight distribution.

Unit-II: Properties of polymer (09 hrs)

- Physical properties including Density (ρ), Solubility, Flammability, Water absorption –Equilibrium (ASTM), Water absorption – over 24 hours,
- Radiation resistance, Ultraviolet (1-380nm) resistance.
- Mechanical Properties including, Crystallinity, Tensile strength (σ_t), Elongation (ϵ) at break, Compressive strength (σ_c), Abrasive resistance, Coefficient of friction (μ) Thermal Properties including Melting temperature (T_m), Glass transition temperature (T_g) & Factor affecting GTT, Heat deflection temperature, Upper working temperature, Lower working temperature, Thermal conductivity (k),
- Chemical Properties including Acids, Alcohols, Alkalis, Aromatic hydrocarbons, Greases & Oils, Halogenated Hydrocarbons, Halogens, Ketones. Infrared Transmittance Spectrum.

Unit-III: Polymerization Techniques (10 hrs)

- Polymerization techniques including three stage addition polymerization,
- Condensation, Ionic and Coordination
- Detail study of the following thermosetting polymers with respect to synthesis, chemistry, properties and application.
- Mechanisms and reaction schemes of different polymerization techniques.

Unit-IV: Polymer Synthesis (10 hrs)

- Phenol – formaldehyde resins.
- Amino resins: Urea formaldehyde and melamine formaldehyde resins.
- Polyurethanes.
- Epoxy resins – Grades of epoxy resins curing process and its importance with mechanism.
- Elastomers – Poly isoprene, Poly butadiene, Neoprene.
- Detailed study of the following thermoplastic polymers with respect to synthesis, chemistry properties and application.
- Poly olefins – Poly ethylene, HDPE, LDPE, LLDE, Polypropylene, Ethylene –
- Propylene co-polymer, PVC, Teflon, Polystyrene.

- Homo polymers, co-polymers such as SBR, ABS, SAN, Polyvinyl acetate and its modifications like PVA, PVB and poly acetals.
- Polyamides – Nylon-6, Nylone-66, and other Nylons.
- Poly ethers and polyesters – Tetraphthaletes, Polycarbonates.

Unit-V: Polymer Processing

(10 hrs)

- Polymer processing introduction
- Compounding
- Molding, Compression molding, Transfer molding, Injection molding, Extrusion molding, Blow molding
- Casting
- Drawing
- Rolling
- Applications of polymers

Text books:

1. Vasant R. Gowariker, 2013 N. V. Viswanathan, Jayadev Sreedhar. Polymer Science, New Age International, 1986 – 11030.
2. Fred W Billmeyer, 2014, Textbook of polymer science, Wiley

Reference Books:

1. J.A. Brydson, Plastics Materials - (Seventh Edition), ISBN-9780750641326, Printbook , Release Date: 1999

16UICCC07	Core Practical-3 Surface Chemistry Practical	06 hrs/wk	03Credits
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Objectives:

1. Analyze colloidal nano-technological and chemical systems, processes and products
2. Use different theories to calculate surface and interfaces tensions and use this to estimate e.g. wetting and other system characteristics
3. Describe the conditions for stability of colloidal systems and discuss and compare different mechanisms for stabilization.
4. Understand the concept for stabilization of emulsions and foam, and design emulsions and foam.

List of Experiments

1. To examine the effect of surfactant on surface tension of liquid.
2. To determine Surface Tension of liquids by drop number method. (Water)
3. To determine Surface Tension of liquids by drop number method. (Benzene)
4. To determine Surface Tension of liquids by drop number method. (Toluene)
5. To determine Surface Tension of liquids by drop number method. (Hexane)
6. To determine Surface Tension of liquids by drop number method. (Xylene)
7. To Synthesize organic compound using Phase Transfer Catalyst (P.T.C.)
8. To prepare Colloidal solution of Oil and Water using Soap.
9. To prepare Colloidal solution of Oil and Water using Detergent.

16UICCC08	Core Practical-4 Polymer Chemistry & Technology Practical	06 hrs/wk	03 Credits
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Objectives:

1. Determine different polymers their properties and access them according to their industrial applications.
2. Study different polymerization techniques & their mechanisms.
3. Know Industrial polymer processing & their engineering aspects.

List of Experiments:

1. Prepare cellulose acetate from cellulose
2. Analyze physical properties of cellulose acetate.
3. Prepare Phenol Formaldehyde polymer.
4. Analyze physical properties of
5. Prepare glyptal resin from phallic anhydride.
6. Analyze physical properties of glyptal resin.
7. Prepare melamine formaldehyde copolymer.
8. Analyze physical properties of melamine formaldehyde.
9. Prepare urea formaldehyde copolymer.
10. Analyze physical properties of urea formaldehyde copolymer.