SAVEETHA ENGINEERING COLLEGE
AUTONOMOUS
Affiliated to Anna University | Approved by AICTE

DEPARTMENT OF CHEMISTRY

LIST OF UG COURSES OFFERED
(Autonomous)

IN CURRICULUM– FLEXIBLE CHOICE BASED CREDIT SYSTEM

Basic Science Courses –Revised
(on Second BOS meeting)
(All courses integrated with laboratory)

S.No.	Course Code	Course Title	Contact Hours Per Week			Credits	Prerequisite	Offered to Department
			L	T	P			
1	19CY201	Engineering Chemistry	**2**	**0**	**2**	**3**	-	Agricultural Engineering
2	19CY202	Chemistry for Biomedical Engineering	**3**	**0**	**2**	**4**	-	Biomedical Engineering
3	19CY203	Chemistry for Civil Engineering	**3**	**0**	**2**	**4**	-	Civil Engineering
4	19CY204	Chemistry for Technologists I	**3**	**0**	**2**	**4**	-	Chemical Engineering
5	19CY205	Principles of Chemistry In Engineering (Common to B.E/B,Tech programmes of AI&DS, CSE, ECE, IT & MED. ELE.,)	**3**	**0**	**2**	**4**	-	Artificial Intelligence and Data Science, Electronics and Communication Engineering, Medical Electronics Engineering, Computer

								Science Engineering & Information Technology
6	19CY206	Principles of Electro Chemistry	**3**	**0**	**2**	**4**	-	Electrical and Electronics Engineering
7	19CY207	Applied Chemistry	**3**	**0**	**2**	**4**	-	Electronics and Instrumentation Engineering
8	19CY208	Basic Engineering Chemistry	**3**	**0**	**2**	**4**	-	Mechanical Engineering
9	19CY209	Chemistry for Technologists II	**3**	**0**	**2**	**4**	-	Chemical Engineering
10	19CY210	Chemistry for Technologists III	**3**	**0**	**2**	**4**	-	

Mandatory Courses

S.No.	Course Code	Course Title	Contact Hours Per Week			Credits	Prerequisite	Offered to Department
			L	T	P			
1	19MC802	Environmental Science	**3**	**0**	**0**	**0**	-	(Common to all B.E/ B.Tech Programmes)

Remarks (Mandatory Course): Students should obtain a Pass in the End Semester Exam

19CY201	ENGINEERING CHEMISTRY	L	T	P	C
		2	0	2	3

Preamble

The objective of this course is to enhance the knowledge of the learners in various aspects such as water analysis, corrosion and unique methods to avoid corrosion. To learn about fuels, materials, Agrochemicals, food chemistry and enzymes to stream line the agricultural production. Know about various analytical methods for evaluating the toxic nature, separation techniques for agricultural applications.

Prerequisite

Basic Course (No Prerequisite)

Course Outcomes

On the successful completion of the course, students will be able to

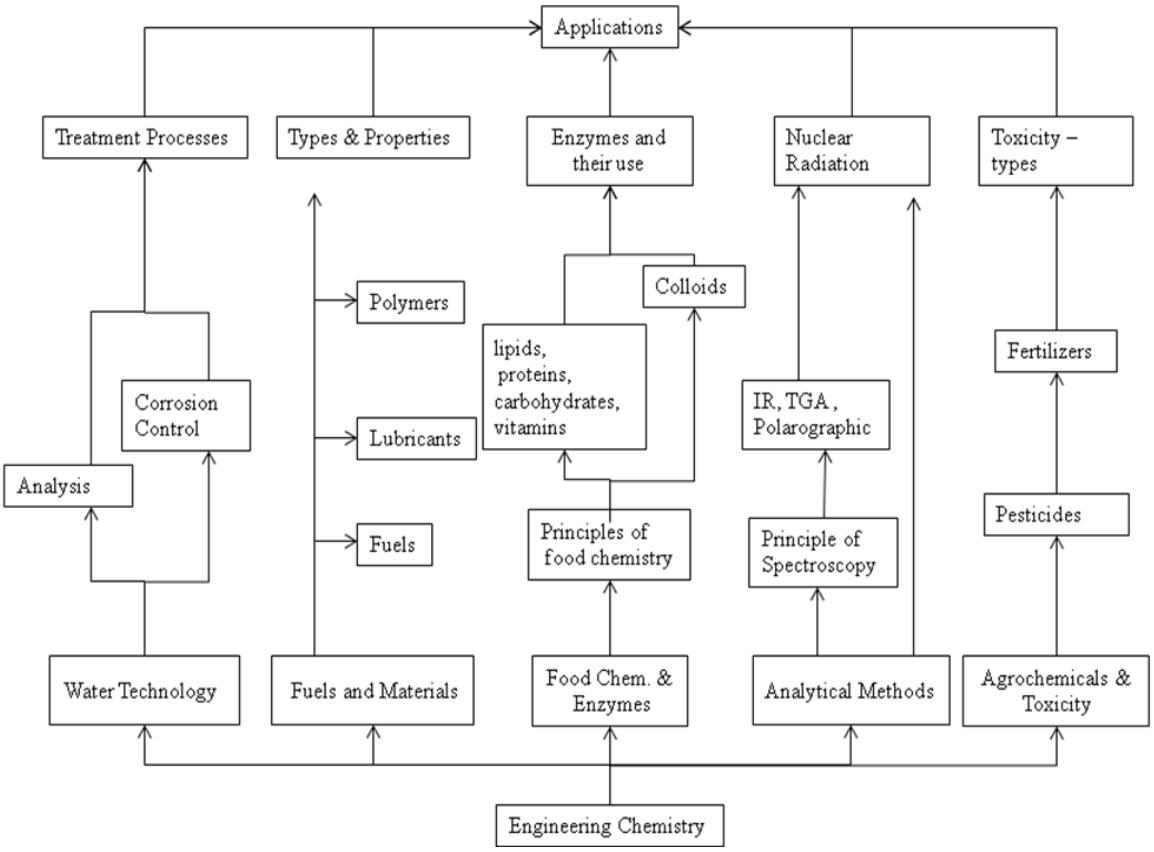
CO1	Develop knowledge on water treatment and corrosion to facilitate better understanding in engineering processes.
CO2	Categorize various fuels and materials with their technological application.
CO3	Infer basic knowledge on food chemistry and enzymes.
CO4	Acquire Fundamental concepts on Analytical techniques.
CO5	Correlate the various types of pesticides, fertilizers and toxicity.

Mapping of COs with POs and PSOs

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	3	3	1	2	2	2	-	-	-	-	-	2	1	-
CO2	3	2	2	2	2	1	1	-	-	-	-	-	2	1	-
CO3	2	2	2	-	-	2	2	-	-	-	-	-	1	2	-
CO4	3	2	2	-	-	2	2	-	-	-	-	-	3	1	-
CO5	3	2	2	-	-	1	1	-	-	-	-	-	2	2	-

3-Strong; 2 - Medium; 1-Low

Concept Map


Applications
Treatment Processes
Types & Properties
Enzymes and their use
Nuclear Radiation
Toxicity – types
Polymers
Colloids
lipids, proteins, carbohydrates, vitamins
Fertilizers
Corrosion Control
IR, TGA, Polarographic
Lubricants
Analysis
Fuels
Principles of food chemistry
Principle of Spectroscopy
Pesticides
Water Technology
Fuels and Materials
Food Chem. & Enzymes
Analytical Methods
Agrochemicals & Toxicity
Engineering Chemistry

SYLLABUS

UNIT I WATER TECHNOLOGY **6+18**

Water: temporary and permanent hardness. Disadvantages of hard water, scale and sludge formation in boilers and boiler corrosion. Corrosion: causes, types and method of prevention.

Determination of temporary and permanent hardness of water by EDTA method.
Estimation of chloride in water.
Estimation of dissolved oxygen in water.
Determination of BOD/COD in water sample.
Estimation of available chlorine in bleaching powder.
Estimation of activity/alkalinity of water sample.
Determination of carbonate and non- carbonate hardness by soda reagent.
Determination of coagulation of water and chloride ion content.
Determination of rate of corrosion by weight loss method.
Analysis strength of given acid/base using pH/conductivity meter.

UNIT II FUELS AND MATERIALS **6+6**

Fuels: classification, calorific value. Lubricants: properties, mechanism, classification and tests. Polymers: types of polymerization, properties, uses and methods for the determination of molecular weight of polymers.

Determination of calorific value of fuel.
Determination of viscosity of oil.
Evaluation of molecular weight/degree of polymerization of polyvinyl alcohol using viscometer (Ostwald /Ubelhode).

UNIT III FOOD CHEMISTRY AND ENZYMES **6**

Principles of food chemistry. Introduction to lipids, proteins, carbohydrates, vitamins, food preservatives, colouring and flavouring reagents of food. Colloids: classification and properties. Enzymes and their use in the manufacturing of ethanol and acetic acid by fermentation methods.

UNIT IV ANALYTICAL METHODS **6+6**

Analytical methods: Introduction to IR spectroscopy, Thermo-gravimetric, polarimeter and polarographic analysis. Molar refraction of organic compounds. Nuclear radiation, detectors and analytical applications of radioactive materials.

Determination of iron content of the water sample/ λmax and verification of Beer Lambert Law using spectrophotometer.
Identification of functional groups (alcohol, aldelyde, ketones, carboxylic acid and amide) from IR spectrum. Chromatographic analysis.

UNIT V AGROCHEMICALS AND TOXICITY **6**

Pesticides & fertilizers: classification, synthesis, specifications. Toxicity- types LD 50 and LC 50 values, toxic chemicals in the environment, biochemical effects of As, Cd, Pb, cyanide and pesticides.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	Name of the Equipments	Number
1	Spectrophotometer	2
2	Bomb calorimeter	1
3	Redwood/ saybolt viscometer	1
4	pH meter	6
5	Oswald/Ubbelohde viscometer	10
6	Weighing balance	5

Common Apparatus: Pipette, Burette, conical flask, Iodine flask, porcelain tile (30 Nos each)

TEXT BOOKS

1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 15th edition, 2015.
2. Bahl B S, Arun Bahl and Tuli B D, Essentials of Physical Chemistry, S. Chand and Co. Ltd., Delhi, 2007.
3. Kannan P. and Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2014.

REFERENCES

1. Gurdeep R. Chatwal, Sharma K. Anand, Instrumental methods of Chemical Analysis, Himalaya Publishers, New Delhi, 2014.
2. P. Kamaraj and M. Arthanareeswari, Applied Chemistry, Sudhandhira Publications,12th edition, 2018.
3. Samuel L. Tisdale, Werner L. Nelson, James D. Beaton, Soil Fertility and Fertilizers, 8th Edition, Pearson publishers, 2013.

4. A.K.De, Environmental Chemistry, New Age International (P) Limited, 7th Edition, 2010.

Course Designers

S.No	Name of the Faculty	Email ID
1	Dr.P.A.Vivekanand	vivekanand@saveetha.ac.in
2	Dr. M.Mettilda	mettilda@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

19CY202	CHEMISTRY FOR BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	2	4

Preamble

The course aims to create sound knowledge on chemistry to employ the concepts in various fields. This involves the better understanding in engineering materials and its applications. Impart depth knowledge on electrodes and unique materials that is essential for an Engineer. Correlate chemical bonding and the nature of materials with theoretical principles of spectroscopy towards myriad applications. Also highlights concepts of thermodynamics and its importance in the engineering field applications.

Prerequisite

Basic Course (No Prerequisite)

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Relate the basic concepts of hybridisation with chemical bonding.	Understand
CO2	Interpret the thermodynamic aspects involved in the biochemical process.	Apply
CO3	Develop the fundamentals of electrochemistry in engineering processes for future applications.	Apply
CO4	Acquire fundamental knowledge on organic chemistry including spectrochemical analysis.	Analyze
CO5	Explain about the wide range of synthetic materials in modern applications.	Understand

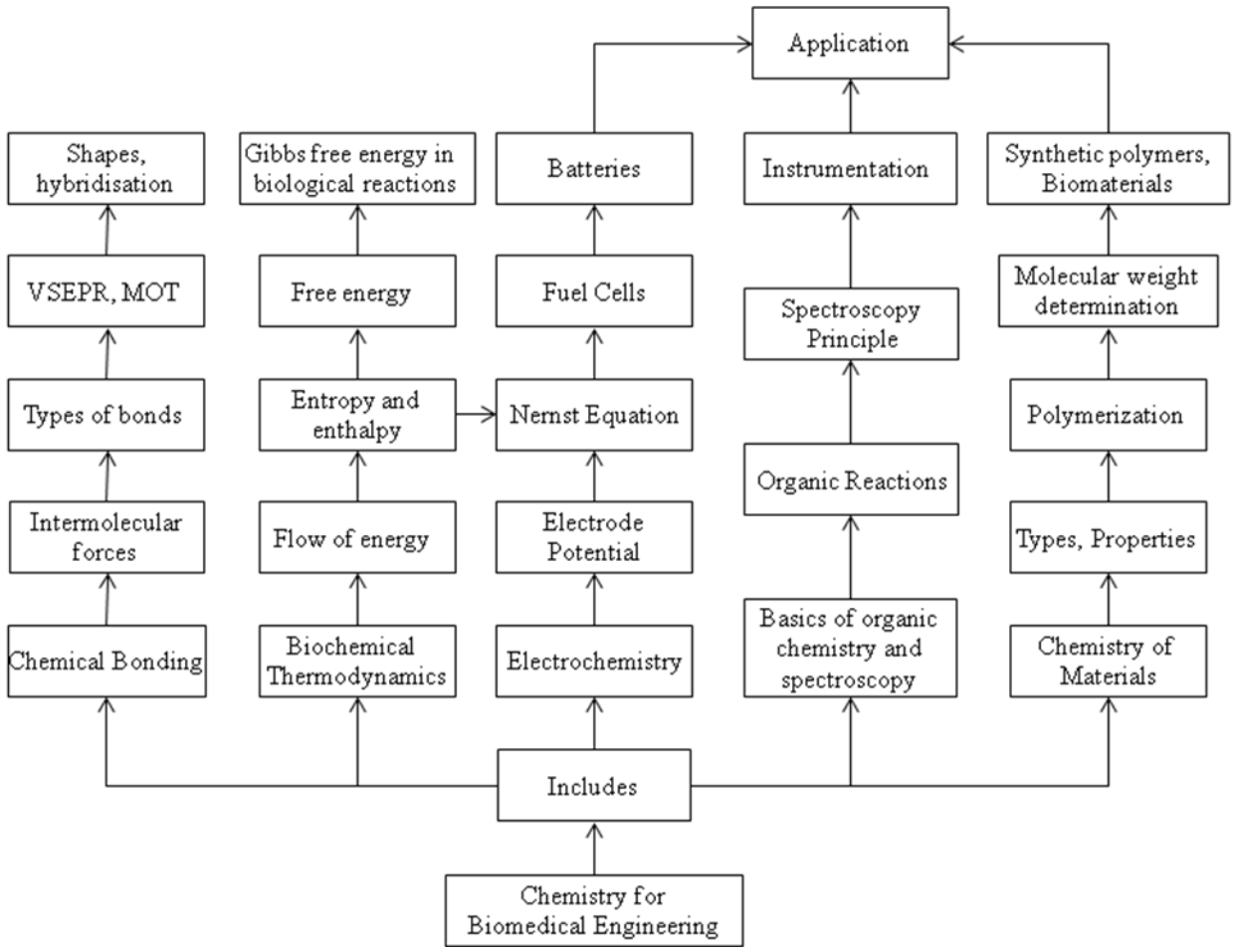
Mapping of COs with POs and PSOs

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	1	-	-	1	-	-	-	-	-	-	1	-	-
CO2	3	3	2	1	1	1	-	-	-	-	-	-	2	1	1
CO3	3	3	3	2	1	1	-	-	-	-	-	-	3	1	1
CO4	3	3	3	2	2	1	-	-	-	-	-	-	2	-	-

CO5	3	2	2	1	1	1	-	-	-	-	-	-	3	2	-

3-Strong; 2 - Medium; 1-Low

Concept Map



SYLLABUS

UNIT I CHEMICAL BONDING **9**

Intermolecular forces – Vander wall and London forces. Valence electrons, ionic bond, covalent bond, Co-ordinate bond - valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s,p and d orbitals and shapes of some simple molecules –MOT, structure, bonding and energy levels, shapes - hydrogen bond.

UNIT II BIOCHEMICAL THERMODYNAMICS **10+3**

System and surroundings. Flow of energy in living organisms – Energy conversion in living organisms. Expressions for work done and heat capacity. Internal energy and enthalpy. Temperature variation of enthalpy. Differential Scanning Calorimetry- enthalpy change from DSC data. Thermal denaturation of protein. Entropy and second law. Life and second law of thermodynamics. Free energy and spontaneity of reactions – Keq and ΔG_0 - energy coupling links in reactions – activation energy of reactions. Gibbs energy of assembly of proteins and biological membranes.

Determination of the heat capacity of benzoic acid, internal energy of combustion of camphor using Bomb calorimeter(Calculation of enthalpy of combustion and formation for camphor).
Determination of calorific value of a fuel using Bomb calorimeter.

UNIT III ELECTROCHEMISTRY **8+18**

Conductance – Types of conductance and its measurement - Glass electrode – pH measurement– Electrochemical cells – Types of electrode potential – Nernst equation – EMF series and its applications – Batteries – Types – Construction, working and applications of Lead acid, Ni-Cd, lithium ion batteries - Fuel cells – H_2 - O_2 , Applications.

Estimation of iron content of the given solution using potentiometer.
Determination of single electrode potential
Compare the strength of acids in a mixture of acids using conductivity meter.
Analysis strength of given acid/base using pH meter.
Determination of strength of an acid/base using conductivity meter.
Quantitative analysis of Barium salt by Conductometric Precipitation titration ($BaCl_2$ vs Na_2SO_4).

UNIT IV BASICS OF ORGANIC CHEMISTRY AND SPECTROSCOPY **9+6**

Basics of Organic Chemistry: Classification of functional groups, Types of Organic reactions- substitution, addition and Elimination. Redox reactions, Named Reactions: Wittig reaction, Birch reduction, Diels- Alder reaction, basics of Click Reactions. Pharmaceutical drugs and its significance.

Principle of Beer- Lambert law, Spectroscopy (Principle, instrumentation and applications): UV – visible – IR spectroscopy – flame emission spectroscopy- atomic absorption spectroscopy. Introduction to Nuclear Magnetic resonance and Magnetic resonance imaging.

Estimation of iron content of the water sample using spectrophotometer.
Estimation of sodium/potassium present in water using flame photometer.
Identification of functional groups (alcohol, aldelyde, ketones, carboxylic acid and amide) from IR spectrum.

UNIT V CHEMISTRY OF MATERIALS **9+3**

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin. Biopolymers. Prosthetic materials-silicone and titanium based materials.

Evaluation of molecular weight / degree of polymerization of polyvinyl alcohol using viscometer (Ostwald /Ubelhode).

TOTAL: 75 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No	Name of the Equipments	Number
1	pH meter	6
2	Conductivity meter	6
3	Potentiometer	6
4	Spectrophotometer	2
5	Flame photo meter	2
6	Ostwald/ ubbelohde Viscometer	10
7	Bomb calorimeter	1

Common Apparatus: Pipette, Burette, conical flask, Iodine flask, porcelain tile

TEXT BOOKS

1. P. C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) LTD, New Delhi, 15th edition, 2015.
2. P. Kannan and A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2013.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2nd edition, 2013.

REFERENCES

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 12th edition, 2015.
2. B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. B.R. Puri, L. R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Company, New Delhi, 47th edition, 2016.
4. M.M. Cox and D.L. Nelson, "Lehninger Principles of Biochemistry", W H Freeman and Co., New York, 2009.
5. Vogel's, "Textbook of Quantitative Chemical Analysis", 8th edition, 2014.

Course Designers:

S.No	Name of the Faculty	Email ID
1	Dr. A. Kalaivani	kalaivania@saveetha.ac.in
2	Dr. A. Saravanan	saravanana@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

19CY203	CHEMISTRY FOR CIVIL ENGINEERING	L	T	P	C
		3	0	2	4

Preamble

The purpose of this course is to enrich the learners in understanding the engineering principles in Water technology and various building materials. Impart depth understanding of principles of electrochemistry, corrosion and its controls for Civil Engineers. Correlate theoretical principles and basics of organic compounds towards advanced composites in the engineering field.

Prerequisite

Basic Course (No Prerequisite)

Course Outcomes

On the successful completion of the course, students will be able to

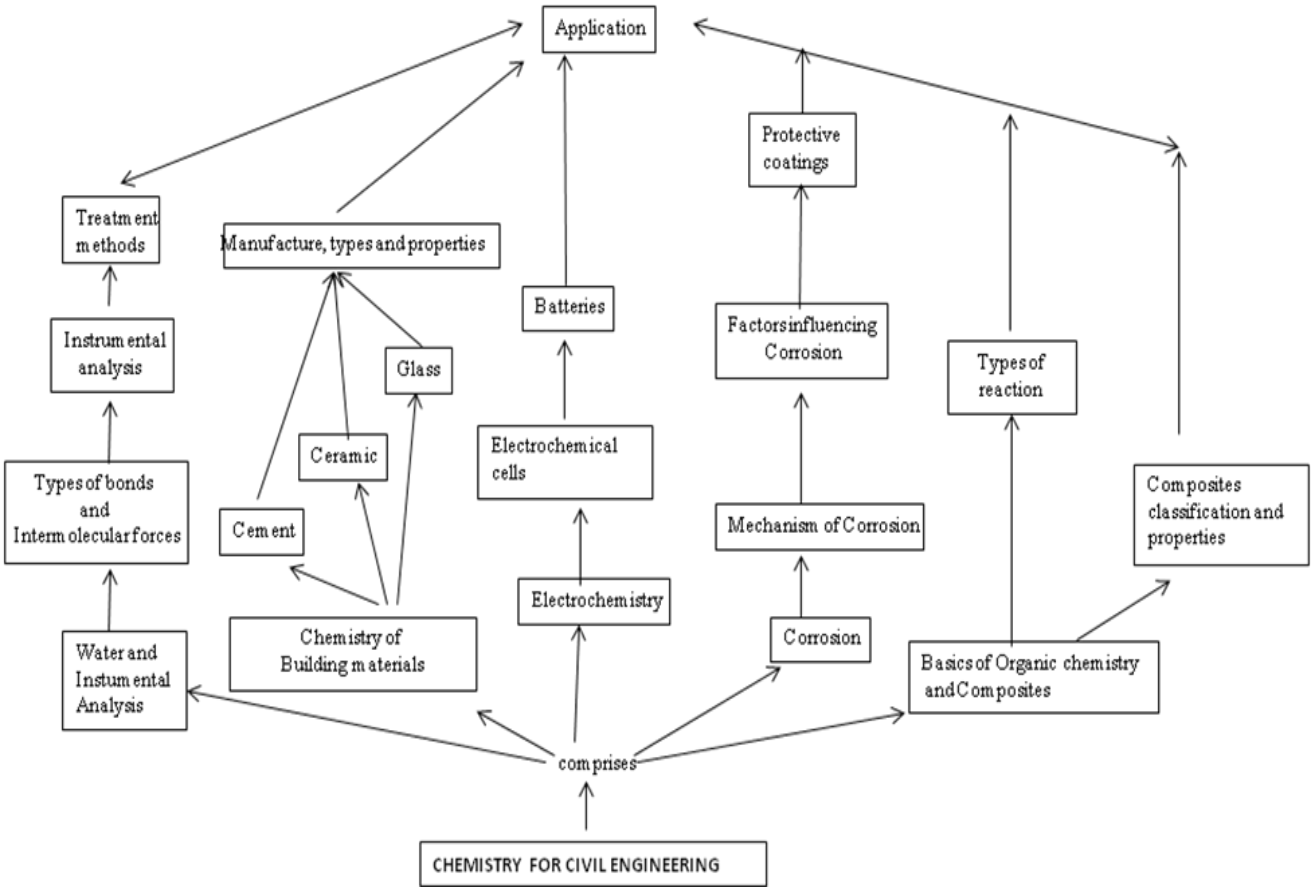
CO1	Infer basic knowledge on water treatment to facilitate the better understanding in engineering processes.	Understand
CO2	Explore the chemistry behind the technology of building materials.	Apply
CO3	Develop the fundamentals of electrochemistry in engineering processes for future applications.	Apply
CO4	Relate the concept of corrosion mechanism to control the corrosion by various methodologies.	Understand
CO5	Analyze physico-chemical characteristics of composites material towards modern application.	Analyze

Mapping of COs with POs and PSOs

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	3	3	3	-	-	-	-	-	3	1	3
CO2	3	3	3	-	-	2	2	-	-	-	-	-	1	1	3
CO3	3	3	1	1	1	1	-	-	-	-	-	-	1	-	3
CO4	3	3	3	-	1	2	2	-	-	-	-	-	1	1	2
CO5	3	3	2	-	-	2	-	-	-	-	-	-	1	-	1

3-Strong; 2 - Medium; 1-Low

Concept Map


Application
Protective coatings
Treatment methods
Manufacture, types and properties
Batteries
Factors influencing Corrosion
Types of reaction
Instrumental analysis
Glass
Ceramic
Electrochemical cells
Types of bonds and Intermolecular forces
Cement
Mechanism of Corrosion
Composites classification and properties
Electrochemistry
Chemistry of Building materials
Corrosion
Water and Instumental Analysis
Basics of Organic chemistry and Composites
comprises
CHEMISTRY FOR CIVIL ENGINEERING

SYLLABUS

UNIT I WATER AND INSTRUMENTAL ANALYSIS 10+15

Basics of bonding, Intermolecular forces – Principles of Vander wall and London forces, hydrogen bonding. Properties of water, sources, quality for different uses-significance of water quality parameter pH, EC, TDS, hardness, chloride, sulphate, iron, fluoride, nitrate, DO, BOD, COD, and heavy metals (As, Hg, Cr, Pb) and their determination by titrimetry, electrometry, UV- visible, AAS, ICP-AES. Softening of water by ion exchange method, municipal water treatment, principle, coagulations, filtration, and disinfection. Desalination by reverse osmosis method.

Analysis the hardness/Cu of water by EDTA method.
Estimation of chloride content of water sample by Argentometric method.
Alkalinity estimation in given water sample.
Determination of Dissolved Oxygen (DO) in given water sample.
Evaluation of iron content of the water sample using spectrophotometer.
Estimation of sodium and potassium present in water using flame photometer.
Quantitative analysis of Barium salt by Conductometric Precipitation titration ($BaCl_2$ vs Na_2SO_4).

UNIT II CHEMISTRY OF BUILDING MATERIALS 9

Introduction-lime: types-manufacture and properties-cement-Portland cement, setting and hardening of cement, types of cement, analysis of cement and dolomite, special cement. Concrete-manufacture and its properties-gypsum plaster. Ceramic-clay products-white ware, stone ware and earthen ware. Glass-manufacture, types, properties and it uses. Fly ash-properties and uses. Chemistry of alloys – significance of alloying – applications.

UNIT III ELECTROCHEMISTRY 8+12

Conductance – Types of conductance and its Measurement – Glass electrode – pH measurement -Electrochemical cells – Types of Electrodes and electrode potential – Nernst equation – EMF series and its applications – Batteries –Types – Fuel cells – principle, construction and working of Lead acid, Ni – Cd, lithium ion batteries and H_2-O_2 fuel cell.

Estimation of iron content of the given solution using potentiometer.
Compare the strength of acids in a mixture of acids using conductivity meter.
Analysis strength of given acid/ base using pH /conductivity meter.

Determination of single electrode potential.

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UNIT IV CORROSION AND ITS CONTROL **11+3**

Introduction-chemical and electrochemical corrosions-mechanism of electrochemical and galvanic corrosions-concentration cell corrosion-passivity-soil, pitting, inter-granular, water line, stress and microbiological corrosions-galvanic series-factors influencing corrosion- measurement of corrosion rate. Corrosion control-material selection and design- electrochemical protection-sacrificial anodic protection and impressed current cathodic protection. Protective coatings-metallic coatings (hot dipping, metal cladding, galvanizing, tinning, electroplating, electroless plating), non-metallic inorganic coatings, organic coatings (paints).

Determination of rate of corrosion by weight loss method.

UNIT V BASICS OF ORGANIC CHEMISTRY AND COMPOSITES **7**

Basics of Organic Chemistry: Classification of functional groups, Types of Organic reactions-substitution, addition and Elimination. Named Reactions: Wittig reaction, Birch reduction, Diels-Alder reaction.

Composites – Introduction – definition – constitution – classification – applications of composite materials – fiber reinforced composites – properties of reinforced composites.

TOTAL: 75 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No	Name of the Equipments	Number
1	pH meter	6
2	Conductivity meter	6
3	Potentiometer	6
4	Spectrophotometer	2
5	Flame photometer	2
6	Weighing balance	5

Common Apparatus: Pipette, Burette, conical flask, Iodine flask, porcelain tile (30 Nos each)

TEXT BOOKS

1. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 15th edition, 2015.

2. P. Kannan P. and A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2013.
3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2nd edition, 2013.

REFERENCES

1. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 12th edition, 2015.
2. Gurdeep R. Chatwal, Sham K. Anand, Instrumental methods of Chemical Analysis, Himalaya Publishers, New Delhi, 5th edition, 2018.
3. B. Sivasankar, “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
4. Ashima Srivastava and N. N. Janhavi, ‘‘Concepts of Engineering Chemistry”, ACME Learning Private Limited, New Delhi, 2010.
5. Vogel’s Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

Course Designers

S. No	Name of the Faculty	Email ID
1	Dr. K. Narendran	Narendran@saveetha.ac.in
2	Dr. A. Saravanan	saravanana@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

19CY204	CHEMISTRY FOR TECHNOLOGISTS I	L	T	P	C
		3	0	2	4

Preamble

The course work aims in disseminating fundamental knowledge on chemical bonding, water treatment, Electrochemistry which is essential for treatment of drinking water and industrial effluent. This enhances the knowledge in Chemistry and its applications relevant to Polymers and Nano materials. It deals with different experiments to practice and apply the concepts studied theoretically to various fields of chemistry.

Prerequisite

Basic course (No pre requisite)

Course Outcomes

On the successful completion of the course, students will be able to

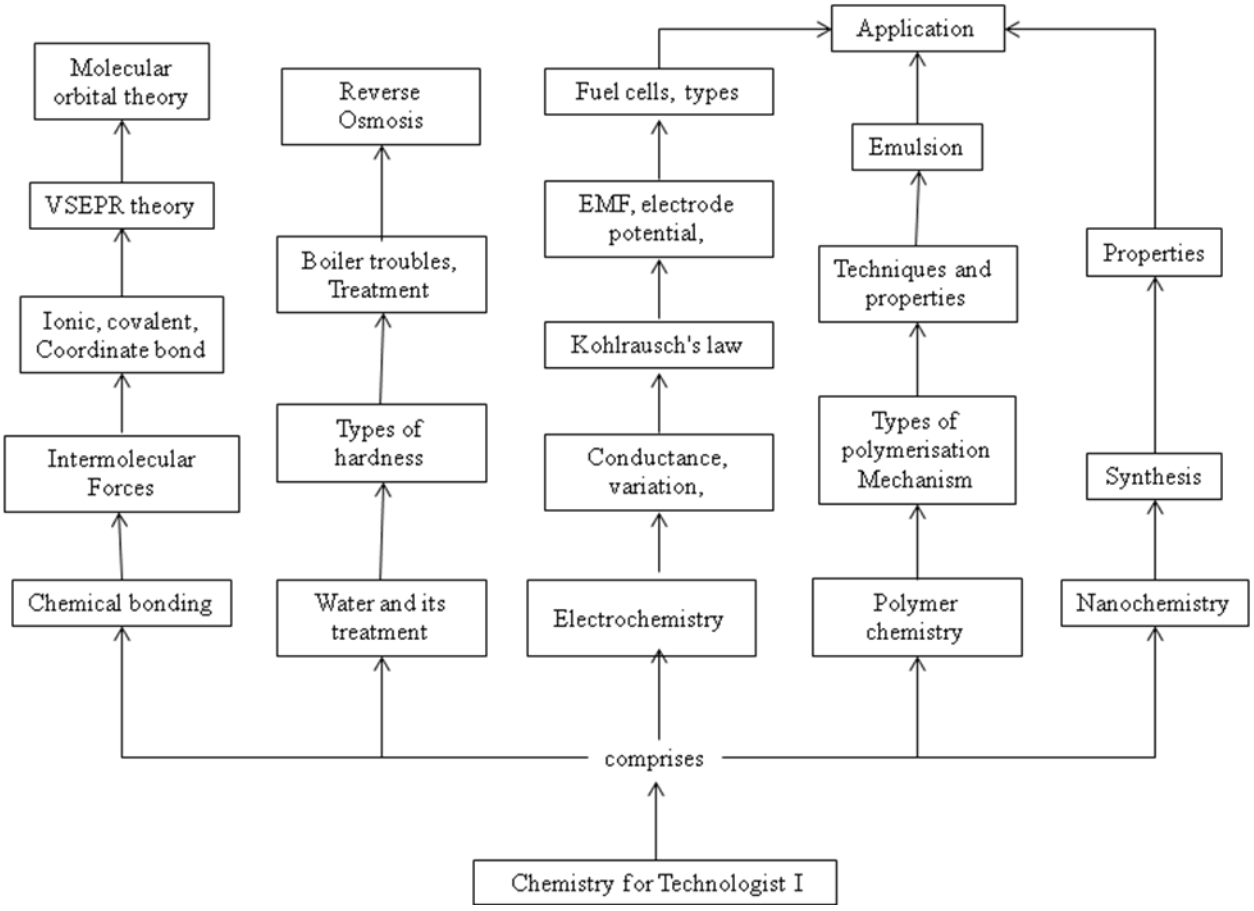
CO1	Relate the basic concepts of hybridisation with chemical bonding.	Understand
CO2	Develop knowledge on water treatment to facilitate better understanding of engineering processes.	Understand
CO3	Correlate the principles involved in Electrochemistry.	Apply
CO4	Identify various types and techniques of polymerisation.	Understand
CO5	Categorize various nanomaterial towards technological approaches	Analyze

Mapping of COs with POs and PSOs

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	1	1	-	1	-	-	-	-	-	-	1	-	-
CO2	3	3	2	2	1	2	2	-	-	-	-	-	1	2	2
CO3	3	3	2	2	1	2	2	-	-	-	-	-	1	2	2
CO4	3	3	2	2	-	2	2	-	-	-	-	-	1	1	1
CO5	3	3	2	2	-	2	-	-	-	-	-	-	1	1	1

3-Strong; 2 - Medium; 1-Low

Concept Map


Application
Molecular orbital theory
Reverse Osmosis
Fuel cells, types
Emulsion
Properties
VSEPR theory
Boiler troubles, Treatment
EMF, electrode potential,
Techniques and properties
Ionic, covalent, Coordinate bond
Kohlrausch's law
Types of hardness
Types of polymerisation Mechanism
Synthesis
Intermolecular Forces
Conductance, variation,
Chemical bonding
Water and its treatment
Electrochemistry
Polymer chemistry
Nanochemistry
comprises
Chemistry for Technologist I

SYLLABUS

UNIT I CHEMICAL BONDING **9**

Intermolecular forces – Vander wall and London forces. Valence electrons, ionic bond, covalent bond, Co-ordinate bond - valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s,p and d orbitals and shapes of some simple molecules –MOT, structure, bonding and energy levels, shapes - hydrogen bond.

UNIT II WATER AND ITS TREATMENT **9+15**

Water quality Parameters-Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

Anal;ysis the hardness of water by EDTA method.
Estimation of Copper in water by EDTA method.
Estimation of chloride content in water sample by Argentometry.
Alkalinity estimation in given water sample.
Determination of Dissolved Oxygen (DO) in given water sample.

UNIT III ELECTROCHEMISTRY **9+ 6**

Electrical Resistance - Specific Resistance - Electrical conductance - Specific Conductance - Equivalent Conductance - Cell Constant - Determination of Cell Constant - Variation of conductance with dilution - Kohlrausch's law - Single electrode potential - Galvanic cell - Cu - Zn cell - EMF and its measurement - Reference electrode - Standard hydrogen Electrode - Calomel electrode - Nernst equation - Electrochemical series - Applications of EMF Measurements.

Determination of Ka of the weak acid.
Determination of single electrode potential.
Verification of Kohlrausch's law and determination of conductance at infinite dilution.

UNIT IV POLYMER CHEMISTRY **9+6**

Basic terminology, classification of Polymers - Types, Mechanism and techniques of polymerization – Bulk, solution, suspension Emulsion polymerization. properties of polymers: Tg, tacticity, molecular weight – weight average, number average and polydispersity index. Preparation, properties and uses of Nylon 6, 6, and Epoxy resin. Biopolymers-PLA.

Determination of molecular weight of polyvinyl alcohol using viscometer (Ostwald/ Ubelhode).
Determination of Degree of polymerization of polyvinyl alcohol using viscometer (Ostwald/ Ubelhode).
Preparation of PMMA by bulk polymerization.

UNIT V NANOCHEMISTRY **9+ 3**

Basics, Distinction between molecule, Nanoparticles and bulk materials, Size dependent properties, Nanoparticle: Nanocluster, Nanorod, Nanotubes, Nanowires and Nanocomposites. Synthesis: (top-down and bottom-up approach) sol-gel, thermolysis, Precipitation, Electrodeposition, Chemical vapour deposition, Laser ablation; Properties and applications. Risk factors and future perspectives.

Synthesis of Nanoparticles by sol-gel method

TOTAL: 75 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No	Name of the Equipments	Number
1	pH meter	6
2	Conductivity meter	6
3	Potentiometer	6
4	Ostwald/ ubbelohde Viscometer	10
5	Water bath	1
6	Magnetic stirrer	5

Common Apparatus: Pipette, Burette, conical flask, Iodine flask, porcelain tile (30 Nos each)

TEXT BOOKS

1. P. C. Jain and Monika Jain, "Engineering Chemistry" DhanpatRai Publishing Company (P) LTD, New Delhi, 15th edition, 2015.
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India Pvt., Ltd., New Delhi, 2nd edition, 2013.
3. P. Kannan and A. Ravikrishnan., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2013.

REFERENCES

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 12th edition, 2015.

2. Friedrich Emich, “Engineering Chemistry”, Scientific International Pvt., Ltd., New Delhi, 2014.
3. Prasanta Rath, “Engineering Chemistry”, Cengage Learning India Pvt., Ltd., Delhi, 2015.
4. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.
5. Vogel’s Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

Course Designers:

S.No	Name of the Faculty	Email ID
1	Dr.M.Mettilda	mettilda@saveetha.ac.in
2	Dr. A. Saravanan	saravanana@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

19CY205	PRINCIPLES OF CHEMISTRY IN ENGINEERING (Common to AI &DS, AI &ML, CSE, ECE, IT & Medical Electronics)	L	T	P	C
		3	0	2	4

Preamble

This course is designed to enhance the knowledge of the learners in chemistry and its applications over diverse engineering domain. Also, it imparts depth understanding on electrodes and speciality materials that is essential for all streams of Engineers. Understand the importance of energy storage devices in creating a more flexible and reliable grid system. Ascertain the importance of biosensors and their role in medical science. Correlate theoretical principles of spectroscopy with myriad applications and also highlights the nanochemistry theory over nanomaterial synthesis and its importance in the engineering field applications.

Basic Course
(No Prerequisite)

Course Outcomes
At the end of the course, the student should be able to

CO1	Develop fundamentals of electrochemistry in engineering processes	Apply
CO2	Impart knowledge on various energy storage sources	Apply
CO3	Categorize various nanomaterial towards technological approaches	Analyze
CO4	Acquires basic knowledge on biosensors materials and spectroscopy.	Analyze
CO5	Classify the wide range of specialty materials for fabrication of integrated circuits in electronics/electrical industry.	Analyze

Mapping of COs with POs and PSOs

B.E - COMPUTER SCIENCE ENGINEERING															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	1	1	1	2	1	-	-	-	-	-	-	1	-	1
CO2	3	2	2	-	-	2	1	-	-	-	-	-	-	-	1	1
CO3	3	1	2	-	-	2	-	-	-	-	-	-	-	1	2	2

CO4	3	2	1	1	1	2	-	-	-	-	-	-	-	1	1	2
CO5	3	1	1	-	-	2	-	-	-	-	-	-	-	2	2	2

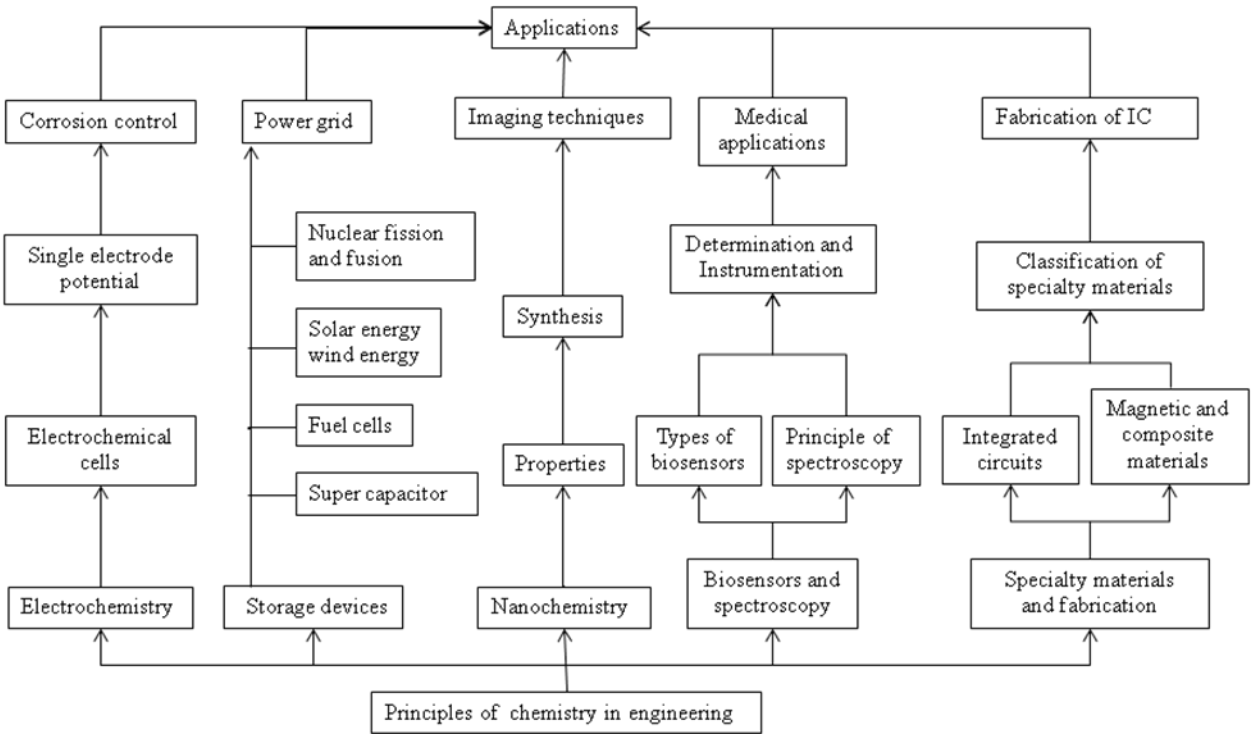
B.E - ELECTRONICS AND COMMUNICATION ENGINEERING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	1	1	2	1	-	-	-	-	-	3	-	-
CO2	3	2	2	-	-	2	1	-	-	-	-	-	3	1	1
CO3	3	1	2	-	-	2	-	-	-	-	-	-	2	1	1
CO4	3	2	1	1	1	2	-	-	-	-	-	-	2	1	-
CO5	3	1	1	-	-	2	-	-	-	-	-	-	2	1	1

B.TECH - INFORMATION TECHNOLOGY															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	1	1	2	1	-	-	-	-	-	1	-	1
CO2	3	2	2	-	-	2	1	-	-	-	-	-	2	1	1
CO3	3	1	2	-	-	2	-	-	-	-	-	-	2	1	1
CO4	3	2	1	1	1	2	-	-	-	-	-	-	1	-	1
CO5	3	1	1	-	-	2	-	-	-	-	-	-	2	1	1

B.E - MEDICAL ELECTRONICS ENGINEERING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	1	1	2	1	-	-	-	-	-	1	1	1
CO2	3	2	2	-	-	2	1	-	-	-	-	-	1	1	1
CO3	3	1	2	-	-	2	-	-	-	-	-	-	3	1	1
CO4	3	2	1	1	1	2	-	-	-	-	-	-	2	1	1
CO5	3	1	1	-	-	2	-	-	-	-	-	-	1	-	-

3-Strong; 2 - Medium; 1-Low

Concept Map


Applications
Corrosion control
Power grid
Imaging techniques
Medical applications
Fabrication of IC
Single electrode potential
Nuclear fission and fusion
Solar energy wind energy
Fuel cells
Super capacitor
Synthesis
Determination and Instrumentation
Classification of specialty materials
Electrochemical cells
Properties
Types of biosensors
Principle of spectroscopy
Integrated circuits
Magnetic and composite materials
Electrochemistry
Storage devices
Nanochemistry
Biosensors and spectroscopy
Specialty materials and fabrication
Principles of chemistry in engineering

Syllabus

UNIT I BASICS OF CHEMICAL BONDING AND ELECTROCHEMISTRY 10+ 24

Basic of Chemical Bonding: Ionic bond, covalent bond, Co-ordinate bond , Intermolecular forces – Principles of Vander wall and London forces, hydrogen bonding.

Electrochemistry: Electrical Resistance - Specific Resistance - conductance - types of conductance - Cell Constant - Determination of Cell Constant - Variation of conductance with dilution - Kohlrausch's law - Single electrode potential - Galvanic cell - Cu - Zn cell - measurement of pH - Nernst equation - Electrochemical series - significance. Principles of chemical and electrochemical corrosion - corrosion control.

Determination of single electrode potential.
Estimation of iron content of the given solution using potentiometer.
Analysis strength of given acid/base using pH/ conductivity meter.
Compare the strength of acids in a mixture of acids using conductivity meter.
Quantitative analysis of Barium salt by Conductometric Precipitation titration ($BaCl_2$ vs Na_2SO_4).
Determination of Dissolved Oxygen (DO) in given water sample.
Determination of rate of corrosion by weight loss method.
Determination of Ka of weak acid.
Verification of Kohlrausch's law and determination of conductance at infinite dilution.

UNIT II STORAGE DEVICES 8

Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- nickel-cadmium battery- -lithium ion battery- fuel cell -H_2 -O_2 fuel cell - applications, Super capacitor- Applications. Nuclear fission- nuclear fusion - nuclear chain reactions- nuclear reactor power generator - breeder reactor- solar energy conversion-solar cell – dye sensitized solar cell- wind energy.

UNIT III NANO CHEMISTRY 7+3

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: Top down and bottom up approaches- imaging techniques (SEM and STM) - Properties – applications.

Synthesis of Nanoparticles by sol-gel method

UNIT IV BIO SENSORS AND ORGANIC SPECTROSCOPY 11+3

Biosensors: Introduction- Advantages and limitations, various components of biosensors, Types of Biosensors.

Organic Spectroscopy: Classification of functional groups, Types of Organic reactions- substitution, addition and Elimination. Redox reactions, Name Reactions: Wittig reaction, Birch reduction, Diels- Alder reaction, Introduction (principle, instrumentation (Block diagram only) and applications)-UV-visible - IR spectroscopy.

Estimation of iron content in the given solution using spectrophotometer.
Verification of Beer-Lamberts law.
Identification of functional groups (alcohol, aldelyde, ketones, carboxylic acid and amide) from IR spectrum.

UNIT V SPECIALITY MATERIALS AND FABRICATION 9

Specialty Materials: Dielectrics & insulating materials – Characteristics; Ceramics – Mica and glass; Magnetic materials – basis of magnetism – Soft and hard magnetic materials; Composites: Classification – Application of composites in electrical and electronic components; Semiconductor – Metallic solids –Characteristics. Fabrication of integrated circuits - Printed circuit boards- Single layer only.

TOTAL: 75 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	Name of the Equipments	Number
1	pH meter	6
2	Conductivity meter	6
3	Potentiometer	6
4	Spectrophotometer	2
5	Weighing Balance	5
6	Magnetic stirrer	5

Common Apparatus: Pipette, Burette, conical flask, Iodine flask, porcelain tile (30 Nos each)

TEXT BOOKS

1. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 15th edition, 2015.
2. P. Kannan P. and A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2013.
3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2nd edition, 2013.

REFERENCE BOOKS

1. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 12th edition, 2015.
2. B.R. Puri and L.R. Sharma, “Principles of Physical Chemistry”, Vishal Publishing Co., 47th Edition, 2016.
3. Loic J Blum, Pierre R Coulet, Biosensors, Principles and Applications, Marcel Dekker,Inc, First edition, 1991.
4. O.P. Khanna, “Material Science” NIH Publications, 2007.
5. Vogel’s Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

Course Designers:

S.No	Name of the Faculty	Email ID
1	Dr. P. A. Vivekanand	vivekanand@saveetha.ac.in
2	Ms. B.Yamini	yamini@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

19CY206	PRINCIPLES OF ELECTRO CHEMISTRY	L	T	P	C
		3	0	2	4

Preamble

This course is designed to impart depth understanding on electrodes and specialty materials that is essential for all streams of Engineers. Understand the importance of energy storage devices in creating a more flexible and reliable grid system. Ascertain the importance of Electrical engineering materials and their properties. Correlate theoretical principles of corrosion, also highlights the corrosion control and its importance in the engineering field applications.

Prerequisite

Basic Course (No Prerequisite)

Course Outcomes

At the end of the course, the student should be able to

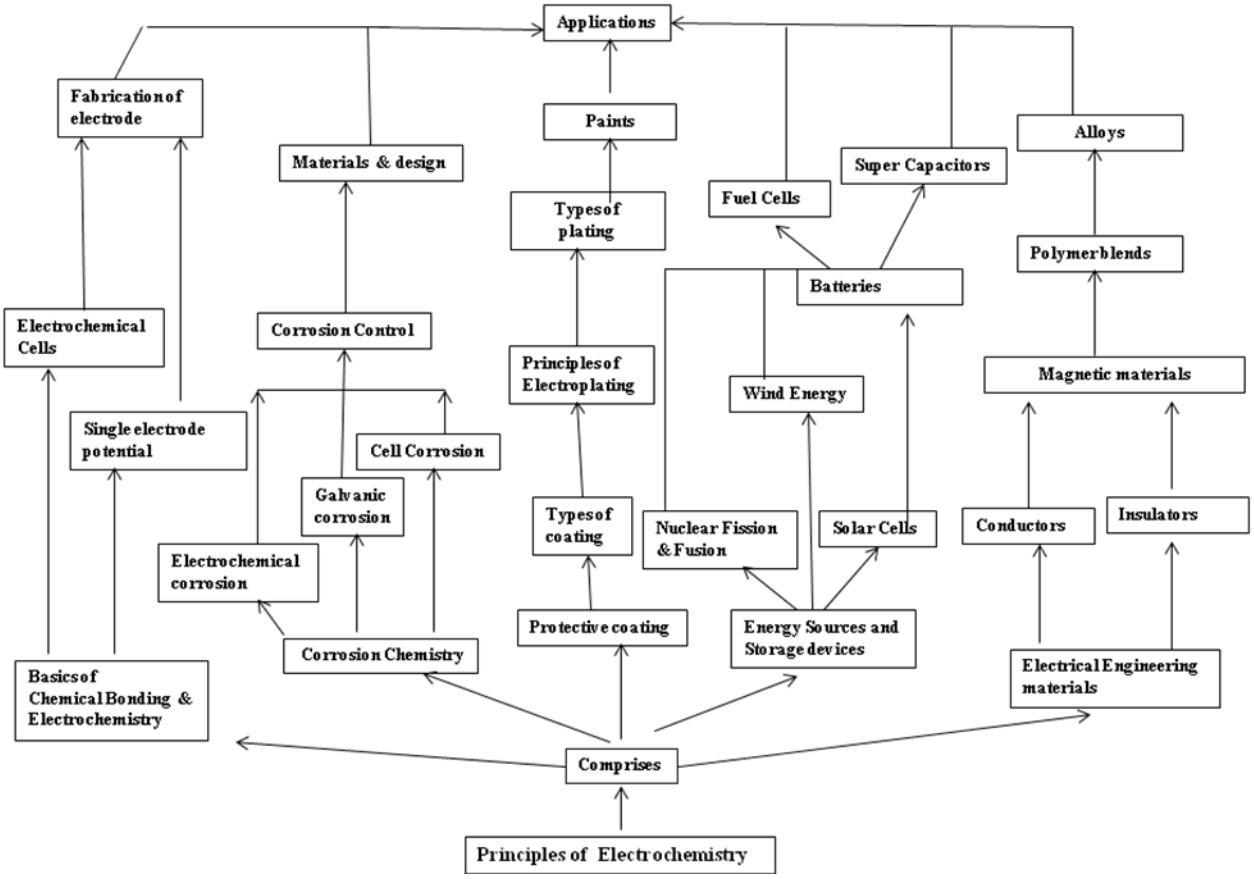
CO1	Develop fundamentals of electrochemistry in engineering processes	Apply
CO2	Relate theory of corrosion towards various control measures.	Understand
CO3	Acquire knowledge about various types of protective coating.	Apply
CO4	Classify various energy sources available for storage.	Analyze
CO5	Categorize the broad domain of electrical engineering materials.	Analyze

Mapping of COs with POs and PSOs

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	1	-	-	-	-	-	-	3	1	1
CO2	3	2	2	1	1	1	1	-	-	-	-	-	3	1	-
CO3	3	2	2	-	1	1	1	-	-	-	-	-	3	1	-
CO4	3	2	2	-	1	1	1	-	-	-	-	-	3	1	1
CO5	3	2	1	-	-	1	-	-	-	-	-	-	3	1	-

3-Strong; 2 - Medium; 1-Low

Concept Map


Applications
Fabrication of electrode
Materials & design
Paints
Fuel Cells
Super Capacitors
Alloys
Types of plating
Polymer blends
Batteries
Electrochemical Cells
Corrosion Control
Principles of Electroplating
Wind Energy
Magnetic materials
Single electrode potential
Cell Corrosion
Galvanic corrosion
Types of coating
Nuclear Fission & Fusion
Solar Cells
Conductors
Insulators
Electrochemical corrosion
Protective coating
Energy Sources and Storage devices
Corrosion Chemistry
Basics of Chemical Bonding & Electrochemistry
Electrical Engineering materials
Comprises
Principles of Electrochemistry

Syllabus

UNIT I BASICS OF CHEMICAL BONDING AND ELECTROCHEMISTRY 10+21

Basic of Chemical Bonding: Ionic bond, covalent bond, Co-ordinate bond - Intermolecular forces – Principles of Vander wall and London forces, hydrogen bonding.

Electrochemistry: Electrical Resistance - Specific Resistance - conductance - types of conductance - Cell Constant - Determination of Cell Constant - Variation of conductance with dilution - Kohlrausch's law - Single electrode potential - Galvanic cell - Cu - Zn cell - measurement of pH - Nernst equation - Electrochemical series - significance.

Determination of strength of given hydrochloric acid/base using pH meter.
Compare the strength of acids in a mixture of acids using conductivity meter.
Analysis of acid/base strength by Conductometric titration (strong acid vs strong base).
Quantitative analysis of Barium salt by Conductometric Precipitation titration ($BaCl_2$ vs Na_2SO_4).
Estimation of iron content of the given solution using potentiometer.
To find single electrode potential/emf using Potentiometer.
Verification of Kohlrausch's law and determination of conductance at infinite dilution.

UNIT II CORROSION CHEMISTRY 9+3

Introduction-chemical and electrochemical corrosions-mechanism- galvanic corrosions-concentration cell corrosion- pitting, water line, stress and microbiological corrosions - galvanic series-factors influencing corrosion- measurement of corrosion rate. Corrosion control-material selection and design- electrochemical protection- sacrificial anodic protection and impressed current cathodic protection.

Comparison of rate of corrosion of metals in the presence of acid, base and neutral medium by weight loss method.
Determination of rate of corrosion of iron in the presence of various acids by weight loss method.

UNIT III PROTECTIVE COATINGS 9+3

Protective coatings- metallic coatings -hot dipping, metal cladding, galvanizing, tinning, electroplating - Principle of electro plating- preparing the surface- types of electro plating- mass plating, rock plating, continuous plating, line plating- electroplating of copper- Importance of

electroplating - Differences between electroplating and electroless plating. Non-metallic inorganic coatings, organic coatings (paints).

Chemical conversion coatings such as chromate and phosphate coatings.

UNIT IV ENERGY SOURCES AND STORAGE DEVICES **8**

Nuclear fission- nuclear fusion - nuclear chain reactions- nuclear reactor power generator - breeder reactor- solar energy conversion - solar cell – dye sensitized solar cell- wind energy. Batteries and fuel cells: Types of batteries- Dry cell - alkaline battery- mercury battery –lead storage battery - nickel cadmium battery-lithium ion battery- fuel cell - H_2 -O_2 fuel cell - solid oxide fuel cell - polymer electrolyte membrane fuel cell (PEMFC) - Super capacitor.

UNIT V ELECTRICAL ENGINEERING MATERIALS **9+3**

Conductors: Silver, Copper, Gold, Aluminium- Semiconductors: Germanium, Silicon, Gallium, Arsenic- Insulating materials: Rubbers, Mica, Plastics, Ceramics, Insulating papers-Magnetic materials:ferromagnetic materials, paramagnetic materials, diamagnetic materials, antiferromagnetic materials, ferrites. Polymer blends and alloys.

Demonstration of electrical properties of insulating materials.

Evaluation of molecular weight/degree of polymerization of polyvinyl alcohol using viscometer (Ostwald /Ubelhode).

TOTAL: 75 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Name of the Equipments	Number
1	pH meter	6
2	Conductivity meter	6
3	Potentiometer	6
4	Weighing balance	5
5	Oswald/ubbelohde viscometer	10

Common Apparatus: Pipette, Burette, conical flask, porcelain tile

TEXT BOOKS

1. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 15th edition, 2015.
2. P. Kannan P. and A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2013.

3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2nd edition, 2013.

REFERENCES

1. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 12th edition, 2015.
2. B.R. Puri and L.R. Sharma, “Principles of Physical Chemistry”, Vishal Publishing Co., 47th Edition, 2016.
3. J.C. Kuriacose and J. Rajaram, “Chemistry in Engineering and Technology”, Tata McGraw-Hill, 2010.
4. T.K Basak., “Electrical engineering Materials” New Age Science, 2009.
5. Vogel’s Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

Course Designers:

S.No	Name of the Faculty	Email ID
1	Ms. J. Latha	latha.j@saveetha.ac.in
2	Dr. A. Saravanan	saravanana@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

19CY207	APPLIED CHEMISTRY	L	T	P	C
		3	0	2	4

Preamble

The course work aims in disseminating fundamental knowledge of water treatment, Electro, thermal and analytical techniques which are essential in understanding and setting a method for treatment of drinking water and industrial effluent. The objective of this course is to enhance the knowledge in Applied Chemistry and its applications relevant to various engineering fields. This course introduces different experiments to practice and apply the concepts studied theoretically to various fields of chemistry especially in water quality parameters and spectroscopy.

Prerequisite

Basic Course (No Prerequisite)

Course Outcomes

On the successful completion of the course, students will be able to

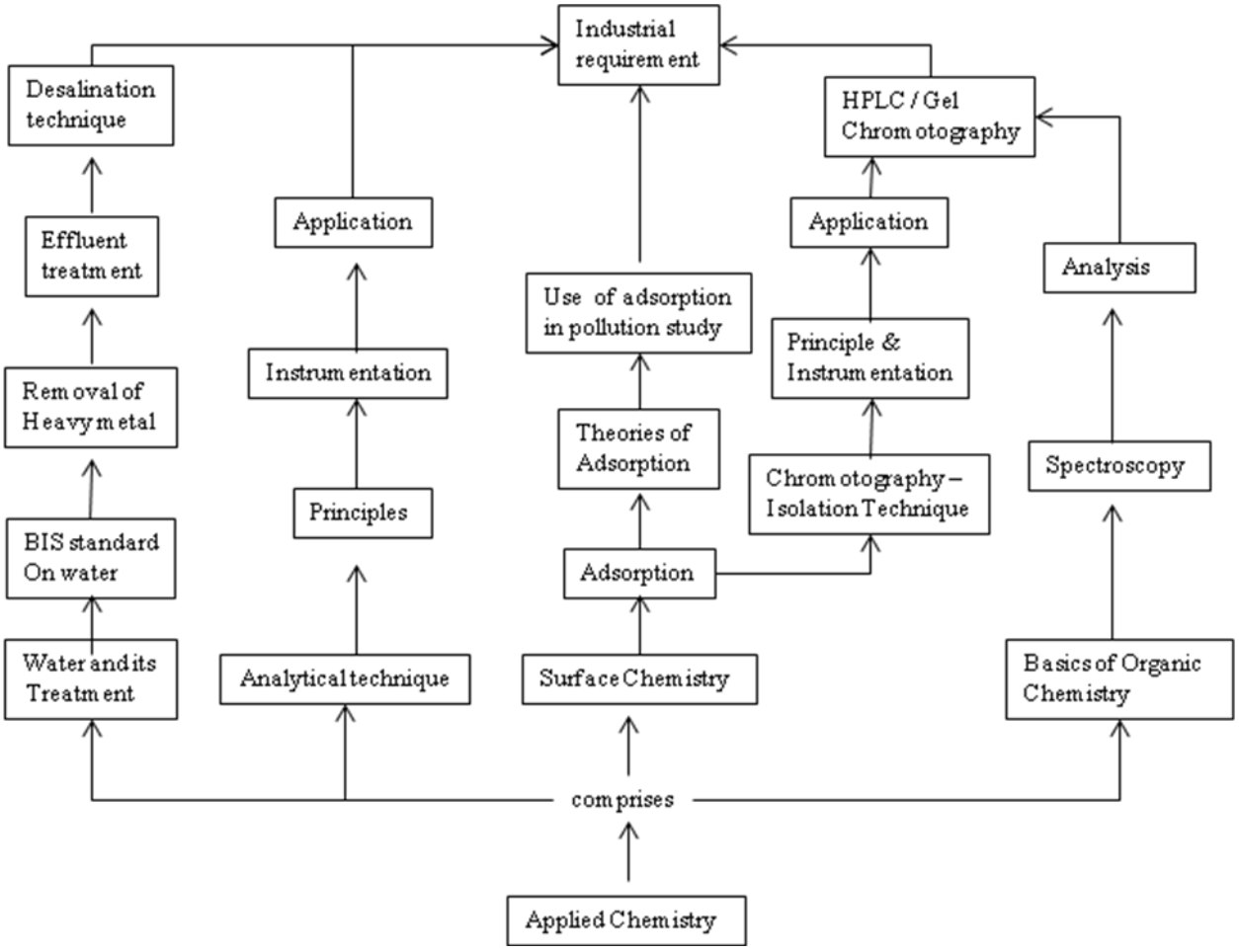
CO1	Develop knowledge on water treatment to facilitate the better understanding of engineering processes.	Understand
CO2	Understand about the principles in various analytical techniques.	Apply
CO3	Classify the view of surface related theory towards pollution control application.	Apply
CO4	Relate the principles of separation for qualitative analysis.	Analyze
CO5	Explain the basics of spectroscopic analysis over various materials.	Understand

Mapping with Programme Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	1	1	-	1	1	-	-	-	-	1	3	1	2
CO2	3	3	3	-	2	2	-	-	-	-	-	1	1	-	-
CO3	3	2	1	-	2	3	-	-	-	-	-	1	2	1	-
CO4	3	2	1	3	-	1	-	-	-	-	-	1	1	-	-
CO5	3	2	3	2	3	-	-	-	-	-	-	2	2	-	-

3-Strong; 2 - Medium; 1-Low

Concept Map



Syllabus

UNIT 1 WATER AND ITS TREATMENT **10+ 12**

Basics of bonding, Intermolecular forces – Principles of Vander wall and London forces, hydrogen bonding - Water quality parameters – Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment - Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

Analysis the hardness/Cu of water by EDTA method.
Estimation of chloride content of water sample by Argentometric method.
Alkalinity estimation in given water sample.
Determination of Dissolved Oxygen (DO) in given water sample.

UNIT II ANALYTICAL TECHNIQUES **9+12**

Principle and applications: Conductometric titrations – Potentiometric titrations, pH-metry – coulometry – voltammetry - polarography, amperometric titrations. Principle, instrumentation and applications: Thermo gravimetric analysis – Differential thermal analysis – Differential scanning calorimetry.

Estimation of iron content of the given solution using potentiometer.
Analysis strength of given acid/base using conductivity meter.
Compare the strength of acids in a mixture of acids using conductivity meter.
Determination of strength of an acid/base using pH meter.

UNIT III SURFACE CHEMISTRY **8+3**

Adsorption : Types of adsorption, adsorption of gases on solids, adsorption of solutes from solution, adsorption isotherm – Frendlich and Langmuir isotherms – contact theory – kinetics of surface reactions - unimolecular reactions, ion exchange adsorption – application of adsorption in pollution abatement.

Determination of adsorption isotherm of (i) acetic acid on charcoal (ii) oxalic acid on charcoal.

UNIT IV CHROMATOGRAPHY- ISOLATION TECHNIQUE **8**

Concepts of chromatography – principle, instrumentation and applications of paper chromatography – column chromatography –Ion-exchange chromatography - thin layer chromatography – gas chromatography – high performance liquid chromatography – gel permeation chromatography.

Demonstration - Separation of organic compounds by TLC or paper chromatography.

UNIT V BASICS OF ORGANIC CHEMISTRY AND SPECTROSCOPY 10+3

Basics of Organic Chemistry: Classification of functional groups, Types of Organic reactions- substitution, addition and Elimination. Redox reactions, Named Reactions: Wittig reaction, Birch reduction, Diels- Alder reaction.

Spectroscopy:(principle, instrumentation (Block diagram only and applications).UV-visible - IR spectroscopy– flame emission spectroscopy, atomic absorption spectroscopy.

Evaluation of iron content of the water sample using spectrophotometer.

Estimation of sodium and potassium present in water using flame photometer.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	Instruments	No. of instruments
1	pH meter	6
2	Conductivity meter	6
3	Potentiometer	6
4	Spectrophotometer	2
5	Flame photometer	2

Common Apparatus: Pipette, Burette, conical flask, Iodine flask, porcelain tile (30 Nos each)

TEXT BOOKS

1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 15th edition, 2015.
2. P. Kannan and A. Ravikrishnan., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2013.
3. D.A. Skoog, D.M. West, F.J. Holler. and S.R. Crouch, Fundamentals of Analytical Chemistry, Thomson Brooks/Cole Publication., Singapore,8th edition, 2004.

REFERENCES

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 12th edition, 2015.

2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2nd edition, 2013.
3. V. Sadasivam , “Modern Engineering Chemistry – A simplified approach”, Kamakya Publications, 2001.
4. Vogel’s Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

Course Designers:

S.No	Name of the Faculty	Email ID
1	Dr. A. Saravanan	saravanana@saveetha.ac.in
2	Dr. S. Bharathi	bharathi@saveetha.ac.in

19CY208	BASIC ENGINEERING CHEMISTRY	L	T	P	C
		3	0	2	4

Preamble

The aim of this course is to create skilled learners in specific areas in various aspects such as water analysis and its treatment. Impart depth understanding on electrodes and unique materials that is essential for all streams of Engineers. Correlate theoretical principles with myriad applications of corrosion and also highlights the energy sources and its importance in the engineering field.

Prerequisite

Basic Course (No Prerequisite)

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Infer basic knowledge on water treatment to facilitate the better understanding in engineering processes.	Understand
CO2	Classify the view of surface adsorption theory towards Industrial application.	Apply
CO3	Summarize about the principles of electrochemistry in corrosion towards its control measures.	Apply
CO4	Identify the various synthetic preparations of fuels to improve its calorific value.	Analyze
CO5	Classify various energy sources available for storage.	Analyze

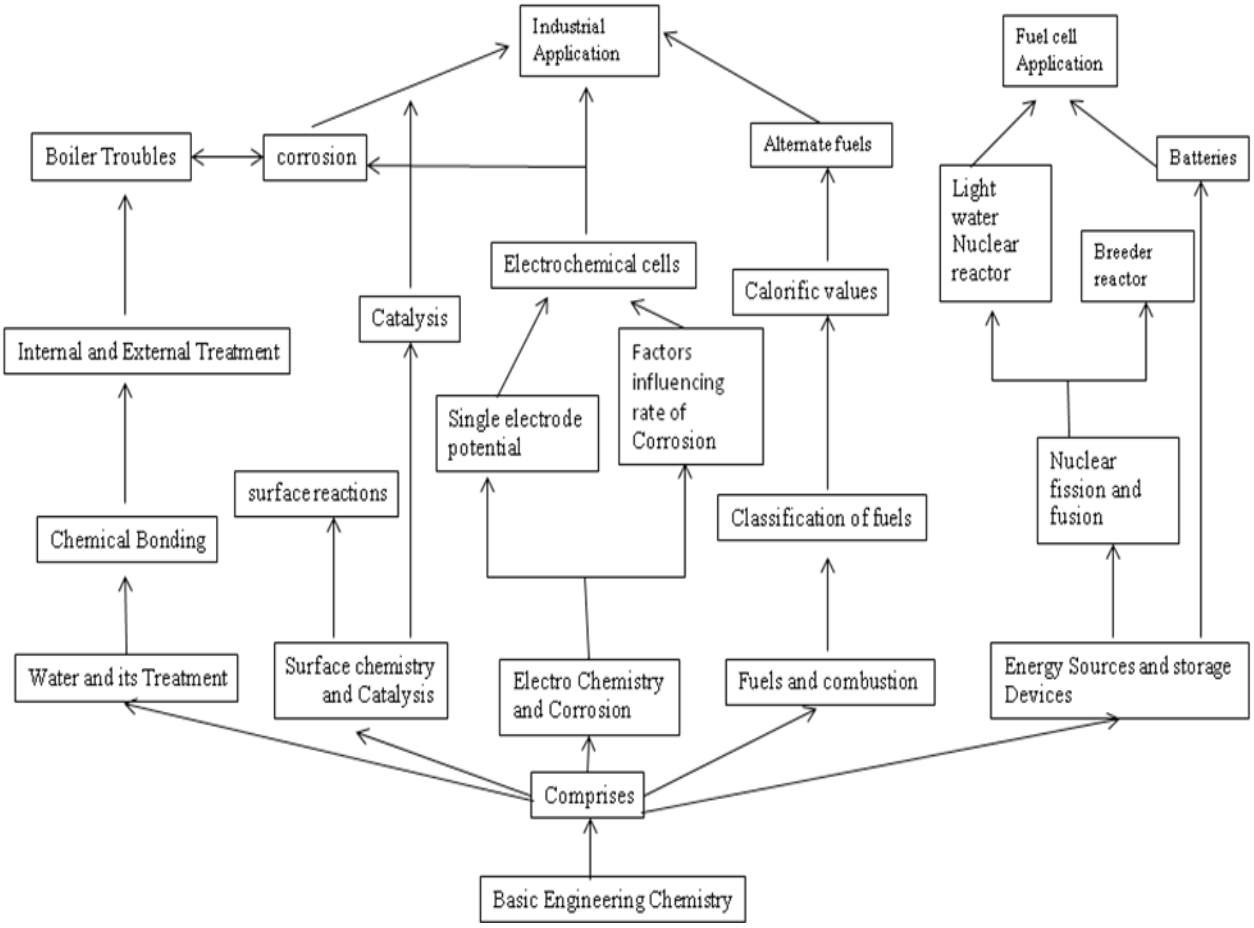
Mapping of COs with POs and PSOs

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	1	-	1	1	-	-	-	-	-	-	1	1
CO2	3	2	1	-	1	1	1	-	-	-	-	-	2	-	-

CO3	3	2	1	1	1	3	1	-	-	-	-	-	2	1	1
CO4	3	2	1	-	-	3	1	-	-	-	-	-	2	1	1
CO5	3	2	1	-	1	3	1	-	-	-	-	-	1	2	1

3-Strong; 2 - Medium; 1-Low

Concept Map



Syllabus

UNIT I WATER AND ITS TREATMENT **9+12**

Basics of bonding, Intermolecular forces – Principles of Vander wall and London forces, hydrogen bonding- water quality parameters - Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

Analysis the hardness of water by EDTA method.
Estimation of heavy metals (Cu) in water by EDTA method.
Alkalinity estimation in given water sample.
Determination of Dissolved Oxygen (DO) in given water sample.
Evaluation of iron content of the water sample using spectrophotometer.
Estimation of sodium and potassium present in water using flame photometer.

UNIT II SURFACE CHEMISTRY AND CATALYSIS **9+3**

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement. Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

Determination of adsorption isotherm of (i) acetic acid on charcoal (ii) oxalic acid on charcoal

UNIT III ELECTROCHEMISTRY AND CORROSION **9+12**

Introduction of Electrochemistry, Electrolytic cells – Reversible and irreversible cells – measurement of emf – Electrode potential - Nernst equation - Types of electrodes - Electrochemical series and Titrations. Types of corrosion (Dry and wet corrosion)- Mechanism, Differential aeration corrosion, water line, pitting and Galvanic corrosion – Factors influencing rate of corrosion – Cathodic protection-sacrifical anode and impressed current method.

Estimation of iron content of the given solution using potentiometer.
Analysis strength of given acid/base using conductivity meter.
Compare the strength of acids in a mixture of acids using conductivity meter.
Determination of strength of an acid/base using pH meter.
Determination of rate of corrosion by weight loss method.

UNIT IV FUELS AND COMBUSTION **9+3**

Fuels: 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 and Fisher tropschs) – knocking – octane number –cetane number – natural gas – compressed natural gas (CNG) – liquefied petroleum gases (LPG) – power alcohol and biodiesel. Combustion of fuels: Introduction – calorific value – theoretical calculation of calorific value – ignition temperature – spontaneous ignition temperature – explosive range – flue gas analysis (ORSAT Method).

Analysis of coal by proximate analysis

UNIT V ENERGY SOURCES AND STORAGE DEVICES **9**

Nuclear fission - controlled nuclear fission - nuclear fusion – differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell), secondary battery (lead acid battery, lithium-ion-battery) - fuel cells - H_2-O_2 fuel cell.

TOTAL: 75 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Name of the Equipments	Number
1	pH meter	6
2	Conductivity meter	6
3	Potentiometer	6
4	Spectrophotometer	2
5	Flame photo meter	2
6	Muffle Furnace	1
7	Weighing balance	5

Common Apparatus: Pipette, Burette, conical flask, Iodine flask, porcelain tile (30 Nos each)

TEXT BOOKS

1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 15th edition, 2015.
2. S. Vairam, P. Kalyani and Suba Ramesh"Engineering Chemistry", Wiley India PVT,LTD, New Delhi,2nd edition, 2013.
3. Kannan P. and Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2013.

REFERENCES

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 12th edition, 2015.
2. M.R. Balasubramanian, S. Krishnamoorthy and V. Murugesan, "Engineering Chemistry", Allied publishers Ltd, 1993.
3. V. Sadasivam, "Modern Engineering Chemistry – A simplified approach", Kamakya Publications, 1999.
4. K.S. Radha, S. Rekha, "Engineering Chemistry I", Cengage Learning India Pvt. Ltd. New Delhi, 2nd edition, 2010.
5. B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi-2008.

Course Designers:

S.No	Name of the Faculty	Email ID
1	Dr. S. Anand	anands@saveetha.ac.in
2	Dr. A. Saravanan	saravanana@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

19CY209	CHEMISTRY FOR TECHNOLOGISTS II	L	T	P	C
		3	0	2	4

Preamble

The purpose of this course is to enrich the learner's knowledge on engineering principles in kinetics and thermochemistry to employ the concepts in various fields. The course aims to create sound knowledge on surface chemistry, catalysis, corrosion and phase rule. Imparts in depth knowledge on Analytical chemistry which is essential for an Engineer.

Prerequisite

No Prerequisite

Course Outcomes

On the successful completion of the course, students will be able to

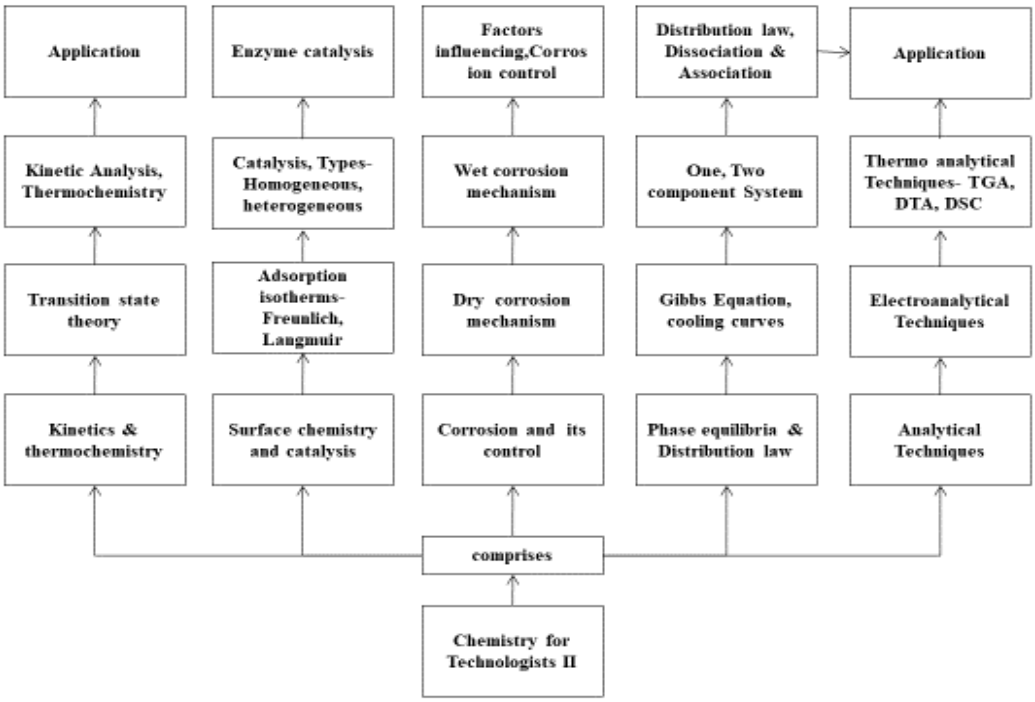
CO1	Develop basic concepts of kinetics and thermochemistry	Apply
CO2	Explain the concepts in depth related to surface chemistry and catalysis	Understand
CO3	Develop the knowledge on corrosion and its control.	Apply
CO4	Relate the Phase equilibria and Distribution law.	Understand
CO5	Infer about the principle involved in various Electro and thermal analytical techniques.	Analyze

Mapping of COs with POs and PSOs

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	1	1	2	-	-	-	-	-	-	1	-	3
CO2	3	2	1	1	-	2	1	-	-	-	-	-	1	1	2
CO3	3	2	2	2	1	2	2	-	-	-	-	-	1	1	1
CO4	3	2	2	2	-	2	-	-	-	-	-	-	1	1	2
CO5	3	3	3	3	3	2	-	-	-	-	-	-	1	1	3

3-Strong; 2 - Medium; 1-Low

Concept Map


Application
Enzyme catalysis
Factors influencing,Corros ion control
Distribution law, Dissociation & Association
Application
Kinetic Analysis, Thermochemistry
Catalysis, Types- Homogeneous, heterogeneous
Wet corrosion mechanism
One, Two component System
Thermo analytical Techniques- TGA, DTA, DSC
Transition state theory
Adsorption isotherms- Freunlich, Langmuir
Dry corrosion mechanism
Gibbs Equation, cooling curves
Electroanalytical Techniques
Kinetics & thermochemistry
Surface chemistry and catalysis
Corrosion and its control
Phase equilibria & Distribution law
Analytical Techniques
comprises
Chemistry for Technologists II

Syllabus

UNIT I KINETICS AND THERMO CHEMISTRY 9+6

Energy Surfaces and Related Concepts: Transition State Theory and Related Topic, Postulates and Principles Related to Kinetic Analysis, Kinetic Experiments; Introduction to Thermo-chemistry- Thermo-chemistry of Stable Molecules and Reactive Intermediates.

Kinetics of ester hydrolysis.
Determination of Rate Constant (K) and Activation Energy.
Determination of the first order rate constant by a graphical treatment of the data.

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9+3

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – applications of adsorption on pollution abatement. Catalysis: Catalyst – types of catalysis – Homogeneous catalysis - Heterogeneous catalysis- criteria – autocatalysis –Acid/Base Catalysis, catalytic poisoning and catalytic promoters – Oxidation, Hydrogenation, Cracking - applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation – Catalysts used in Indian industries.

To study the adsorption of Acetic acid on charcoal and construct the isotherm.
To study the adsorption of oxalic acid on charcoal and construct the isotherm.

UNIT III CORROSION AND ITS CONTROL 9+3

Introduction - Dry or Wet corrosion Types - Wet or Electrochemical Corrosion - Mechanism - Galvanic corrosion - Concentration Cell Corrosion - Soil Corrosion - Pitting Corrosion - intergranular corrosion - pipeline corrosion - Water line Corrosion - Factors influencing Corrosion and Corrosion Control.

Determination of rate of corrosion by weight loss method.

UNIT IV PHASE EQUILLIBRIA AND DISTRIBUTION LAW 9+3

Phase - Components - Degrees of freedom - The Gibbs Phase rule - Derivation of the Phase rule - One Component system - The water System - The Sulphur System - Two Component system - Simple Eutectic System - Thermal analysis - cooling curves - Lead-Silver System - Desilverization of Lead - Distribution Co-efficient - Distribution Law - Conditions for the

validity- I_2-CCl_4 - H_2O System Nature of interaction of the solute with one of the solvents - Dissociation - Association - applications of Distribution law - Process of Extraction

Determination of eutectic composition of biphenyl -naphthalene system.

UNIT V ANALYTICAL TECHNIQUES **9+15**

Principle and applications: Conductometric titrations – Potentiometric titrations, pH-metry – coulometry – voltammetry - polarography, amperometry. Principle, instrumentation and applications: Thermo gravimetric analysis – Differential thermal analysis – Differential scanning calorimetry.

Estimation of iron content of the given solution using potentiometer.
Compare the strength of acids in a mixture of acids using conductivity meter.
Analysis strength of given acid/base using conductivity meter.
Quantitative analysis of Barium salt by Conductometric Precipitation titration ($BaCl_2$ vs Na_2SO_4).
Determination of strength of an acid/base using pH meter.

TOTAL: 75 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	Name of the Equipment	Number
1	pH meter	6
2	Conductivity meter	6
3	Potentiometer	6
4	Weighing balance	5

Common Apparatus: Pipette, Burette, conical flask, Iodine flask, porcelain tile

TEXTBOOKS

1. P. C. Jain and Monika Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) LTD, New Delhi, 15th edition, 2015.
2. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, 3rd Edition, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2nd edition, 2013.
4. P. Kannan and A. Ravi Krishnan., “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2013.

REFERENCES

1. D.A. Skoog, D.M.West, F.J. Holler. and S.R. Crouch, Fundamentals of Analytical Chemistry, Thomson Brooks/Cole Publication., Singapore, 8th edition 2004.
2. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 12th edition, 2015.
3. B.K. Sharma, "Industrial chemistry", Krishna Prakashan Media (P) Ltd, Meerut, 2011.

Course Designers:

S.No	Name of the Faculty	Email ID
1	Dr. M. Mettilda	mettilda@saveetha.ac.in
2	Dr. A. Saravanan	saravanana@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

19CY210	CHEMISTRY FOR TECHNOLOGISTS III	L	T	P	C
		3	0	2	4

Preamble

The objective of this course is to Summarize the importance of Oils, fats, soaps and lubricants and to improve the understanding in stereochemistry, unit process and organic reaction mechanisms. To enhance the knowledge in Organic naming reactions and spectroscopic application in industry.

Prerequisite

No Prerequisite

Course Outcomes

On the successful completion of the course, students will be able to

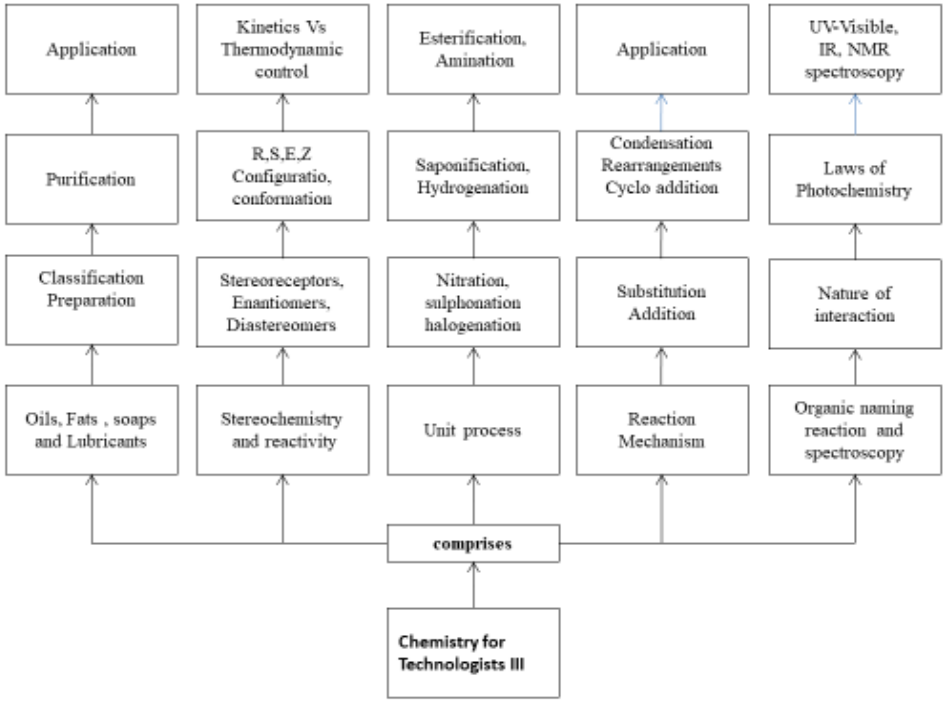
CO1	Correlate the various properties, applicability of oils, fats, soap and lubricants.	Apply
CO2	Correlate Stereochemistry, conformation and reactivity	Analyze
CO3	Interpret various types of chemical reactions, its applications in industries	Understand
CO4	Summarize about the mechanisms involved in addition, substitution, rearrangement reactions	Understand
CO5	Compare various organic naming reactions and spectroscopic application.	Analyse

Mapping of COs with POs and PSOs

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	2	1	-	2	1	-	-	-	-	-	1	1	3
CO2	3	3	1	1	2	1	-	-	-	-	-	-	1	-	1
CO3	3	3	1	1	-	2	1	-	-	-	-	-	3	2	2
CO4	3	3	1	1	-	1	-	-	-	-	-	-	1	-	1
CO5	3	2	1	2	-	2	2	-	-	-	-	-	2	2	2

3-Strong; 2 - Medium; 1-Low

Concept Map



Syllabus

UNIT I OILS, FATS, SOAPS AND LUBRICANTS 9+ 6

Chemical constitution, Chemical analysis of oils and fats – acid, saponification and iodine values, Definitions, determinations and significance. Definition, mechanism of lubrication, preparation of Petro lubes, desirable characteristics – viscosity, viscosity index, carbon residue, oxidation stability, flash and fire points, cloud and pour points, aniline point. Semisolid lubricant – greases, preparation of sodium, lithium, calcium and axle greases and uses, consistency test and drop point test. Solid lubricants – graphite and molybdenum disulphide.

Determination of Redwood / Say bolt numbers, kinematic viscosity and viscosity index of Lubricating oils.
Determination of flash point, fire point, cloud and pour point of oils.
Determination of acid value and iodine value of oils.
Soap Analysis a. Estimation of total fatty acid b. Estimation of percentage alkali content.

UNIT II STEREOCHEMISTRY AND REACTIVITY 9

Introduction to Stereochemistry: Stereo descriptors – R, S, E, Z. Enantiomers and Diastereomers. Racemates and their resolution. Conformations of cyclic and acyclic systems. Reactivity of organic molecules: factors influencing acidity, basicity and nucleophilicity of molecules, kinetic vs. thermodynamic control of reactions.

UNIT III UNIT PROCESSES 9+6

Nitration, Sulphonation, Halogenation, Esterification, Amination, Saponification and Hydrogenation – Role of the unit processes in industries: petroleum, drugs, pharmaceuticals and organic synthesis.
Organic Preparation:
Hydrolysis – Preparation of salicylic acid from methyl salicylate.
Oxidation – Preparation of benzoic acid from benzaldehyde/ benzyl alcohol.
Acetylation – Preparation of acetanilide from aniline.

UNIT IV REACTION MECHANISM 9+3

Free radical, substitutions, electrophilic, addition, aromatic electrophilic substitutions, nucleophilic additions, condensation reactions, nucleophilic substitutions in aliphatic and aromatic compounds, cyclo-additions, rearrangements reactions.

Organic Preparation:
Substitution – Conversion of acetone to iodoform.
Nitration – Preparation of m-dinitrobenzene from nitrobenzene.

UNIT V ORGANIC NAMING REACTIONS AND SPECTROSCOPY 9+15

Mechanism - Friedel craft reaction, Diels alder reaction, Ozonolyzis, Wittig reaction, Aldol condensation, Suzuki coupling, Dieckmann condensation- Negishi coupling – Basics of Flow chemistry. Laws of photochemistry - Principle, instrumentation and interpretation of organic molecules - UV-visible - IR – NMR spectroscopy.

Quantitative analysis of organic compounds – Identification of aliphatic/aromatic, saturated/unsaturated compounds.
Identification and characterization of various functional groups by their characteristic reactions:
a) alcohol b) aldehyde c) ketone d) carboxylic acid e) phenol f) ester
g) primary, secondary and tertiary amines h) nitro compounds.

TOTAL: 75 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	Name of the Equipment	Number
1	Redwood/ say bolt viscometer	1
2	Pensky martens closed cup apparatus	1
3	Cleveland open cup apparatus	1
4	Cloud point, Pour point apparatus	1
5	Weighing balance	1
6	Bunsen burners	30
7	LPG Cylinder	1
8	Hot Air Oven	1
9	Hot Plate	3
10	Water Bath	6
11	Deep freezer	1
12	Magnetic Stirrer	5

13	Mechanical Stirrer	2
14	Reflux Set up	15
15	Melting point apparatus	1

Common Apparatus: Pipette, Burette, conical flask, Iodine flask, porcelain tile

TEXT BOOKS

1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company Pvt. Ltd, New Delhi, 15th edition, 2015.
2. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 3rd Edition, 2015.
3. Tiwari K.S. and Vishnoi N.K., "A Textbook of Organic Chemistry ", Vikas Publishing House, New Delhi, 2007.
4. B.S.Bhal and Arun Bhal, "A Text Book of Organic Chemistry", S Chand & Co. New Delhi, 17th Edition, 2005.

REERENCES

1. B.K. Sharma, "Industrial chemistry", Krishna Prakashan Media (P) Ltd, Meerut, 2011.
2. Felix A. Carroll, ―Perspectives on Structure and Mechanism in Organic Chemistry‖, John Wiley & Sons, 2011.
3. R.T. Morrison and R.N. Boyd "Organic Chemistry", Prentice Hall Inc. USA, 7th edition, 2010.
4. W.L. Mc Cabe, J.C. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw Hill Education, 7th Edition, 2005.

Course Designers:

S.No	Name of the Faculty	Email ID
1	Dr.M.Mettilda	mettilda@saveetha.ac.in
2	Dr. A. Saravanan	saravanana@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

19MC802	ENVIRONMENTAL SCIENCE (Common to all branches of B.E / B.Tech Programmes)	L	T	P	C
		3	0	0	0

Preamble

To inculcate knowledge on environment and all sorts of biotic and abiotic components related to its ecosystem, climate changes and challenges faced due to the global warming and the importance of renewable sources of energy. Inspire students to find ways in contributing personally and professionally thereby rectify environmental and social problems.

Prerequisite

Nil

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1	Explain about ecosystem, their structure, function to conserve biodiversity.	Understand
CO2	Recognize natural resources to maintain ecological balance.	Understand
CO3	Explain about the role of a human being in maintaining a clean sustainable environment for the future generations.	Apply
CO4	Identify the social problems in the environment to reduce social issues.	Understand
CO5	Create awareness about the importance of family welfare, Effect of technology on the environment.	Analyze

Mapping of COs with POs and PSOs

B.E - AGRICULTURE ENGINEERING														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	-

CO2	1	1	-	-	-	1	2	1	1	-	-	-	1	1	1
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	1	1
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	1	1
CO5	2	-	1	-	1	2	2	2	1	-	-	-	1	1	1

B.E - BIO MEDICAL ENGINEERING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	-
CO2	1	1	-	-	-	1	2	1	1	-	-	-	-	-	-
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	3	2
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	2	2
CO5	2	-	1	-	1	2	2	2	1	-	-	-	3	2	2

B.TECH - CHEMICAL ENGINEERING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	-
CO2	1	1	-	-	-	1	2	1	1	-	-	-	-	-	-
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	2	2
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	1	2
CO5	2	-	1	-	1	2	2	2	1	-	-	-	1	1	1

B.E - CIVIL ENGINEERING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	1	2	1
CO2	1	1	-	-	-	1	2	1	1	-	-	-	1	1	1
CO3	1	1	2	-	1	3	2	2	1	-	-	-	3	2	2
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	2	1
CO5	2	-	1	-	1	2	2	2	1	-	-	-	-	1	1

B.E - COMPUTER SCIENCE ENGINEERING																
CO	**P O1**	**P O2**	**P O3**	**P O4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**	**PS O4**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	-	1

CO2	1	1	-	-	-	1	2	1	1	-	-	-	-	1	-	1
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	1	1	1
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	1	-	1
CO5	2	-	1	-	1	2	2	2	1	-	-	-	2	2	1	1

B.E - ELECTRONICS AND INSTRUMENTATION ENGINEERING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	-
CO2	1	1	-	-	-	1	2	1	1	-	-	-	-	-	-
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	2	2
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	1	2
CO5	2	-	1	-	1	2	2	2	1	-	-	-	1	1	1

B.E - ELECTRONICS AND COMMUNICATION ENGINEERING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	-
CO2	1	1	-	-	-	1	2	1	1	-	-	-	-	-	-
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	1	1
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	-	1
CO5	2	-	1	-	1	2	2	2	1	-	-	-	1	1	1

B.E - ELECTRICAL AND ELECTRONICS ENGINEERING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	-
CO2	1	1	-	-	-	1	2	1	1	-	-	-	-	-	-
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	2	1
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	-	1
CO5	2	-	1	-	1	2	2	2	1	-	-	-	2	1	1

B. TECH - INFORMATION AND TECHNOLOGY															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**

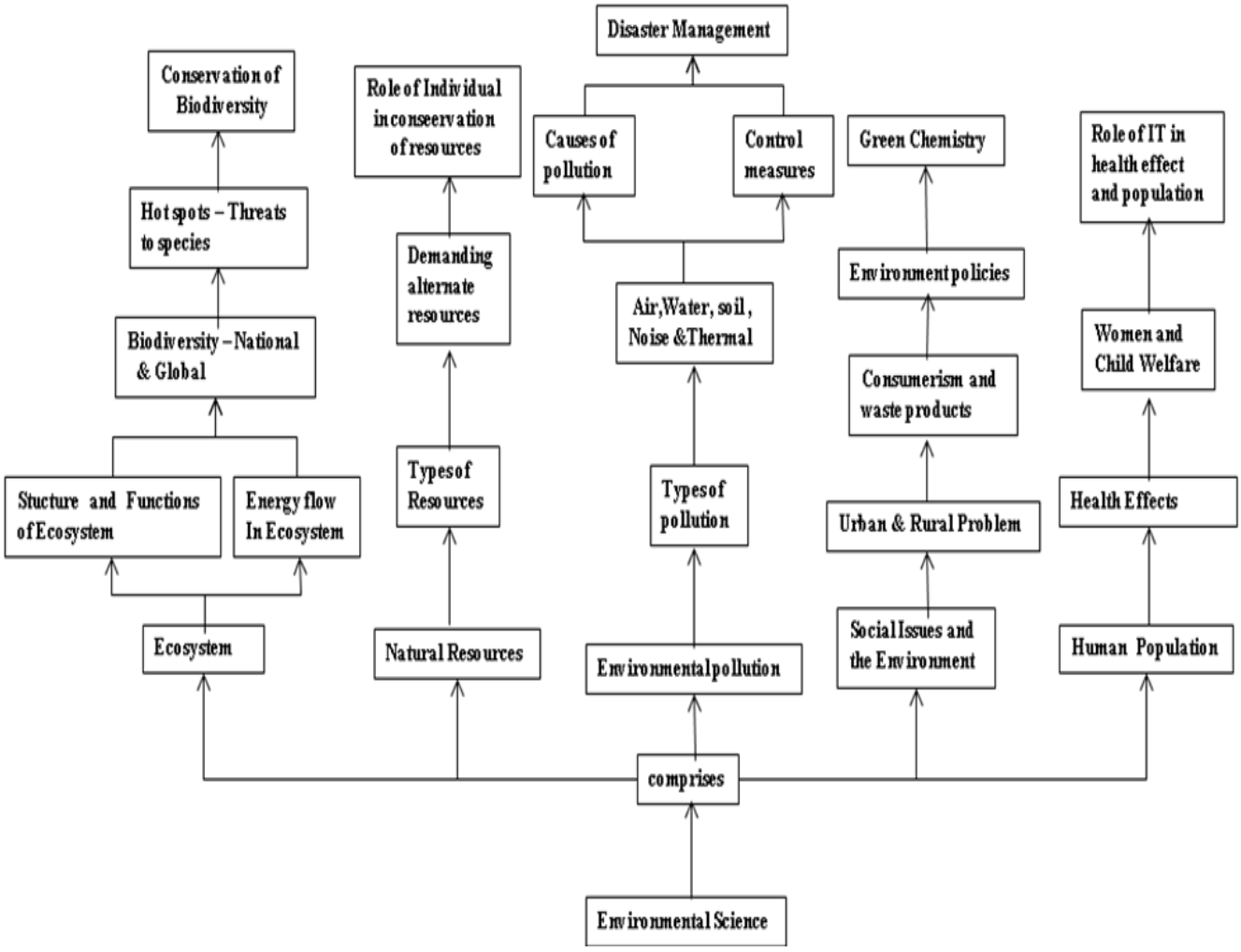
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	1
CO2	1	1	-	-	-	1	2	1	1	-	-	-	-	1	1
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	1	2
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	1	2
CO5	2	-	1	-	1	2	2	2	1	-	-	-	1	1	2

B.E - MECHANICAL ENGINEERING														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	-
CO2	1	1	-	-	-	1	2	1	1	-	-	-	1	1	1
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	1	1
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	-	1
CO5	2	-	1	-	1	2	2	2	1	-	-	-	1	1	1

B.E - MEDICAL ELECTRONICS ENGINEERING														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	-	-	-	1	2	1	1	-	-	-	-	-	-
CO2	1	1	-	-	-	1	2	1	1	-	-	-	-	2	-
CO3	1	1	2	-	1	3	2	2	1	-	-	-	2	2	2
CO4	1	-	-	-	-	1	2	3	1	-	-	-	-	-	1
CO5	2	-	1	-	1	2	2	2	1	-	-	-	2	1	2

3-Strong; 2 - Medium; 1-Low

Concept Map


Disaster Management
Conservation of Biodiversity
Role of Individual in conseervation of resources
Causes of pollution
Control measures
Green Chemistry
Role of IT in health effect and population
Hot spots – Threats to species
Demanding alternate resources
Air,Water, soil, Noise &Thermal
Environment policies
Women and Child Welfare
Biodiversity – National & Global
Consumerism and waste products
Stucture and Functions of Ecosystem
Energy flow In Ecosystem
Types of Resources
Types of pollution
Urban & Rural Problem
Health Effects
Ecosystem
Natural Resources
Environmental pollution
Social Issues and the Environment
Human Population
comprises
Environmental Science

Syllabus

UNIT I ECOSYSTEMS AND BIODIVERSITY 12

Concept, structure, function and energy flow in the various ecosystem – Food-chain &web, ecological succession. Biodiversity-Introduction– Levels– genetic & species – biogeographical classification of India, Biodiversity at global and national level– endangered and endemic species of India - hotspots – threats – conservation of biodiversity: Field study of simple ecosystems .

UNIT II ENVIRONMENT AND NATURAL RESOURCES 9

Need for public awareness on natural resources. Forest resources – exploitation, causes and consequences of deforestation. Water resources – effects of over utilization of surface and subsurface water, dams benefits and problems. Land resources – Land degradation, landslides, soil erosion and desertification. Demanding alternate energy resources- Role of an individual in conservation of natural resources, Indian Case studies for all the resources.

UNIT III ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – role of an individual in prevention of pollution. Disaster management - Case study of polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

Urban problems related to energy and sustainable development – Water Crisis-remedial measures. Solutions related to rehabilitation policy – Consumerism and waste products - Environment Protection Act - Air, Water, Wildlife –drawbacks. International agreements & protocols. The Biomedical Waste Management – Eco mark products. Green chemistry – Principles.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Human population growth: Impacts on environment, human health and welfare - Human rights and laws pertaining to environment, value education, HIV/AIDS, women and child welfare - Role of information technology in human health & Environment.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Benny Joseph, Environmental Science and Engineering", Tata Mc Graw-Hill, New Delhi, 2nd edition, 2008.
2. Anubha Kaushik and C.P. Kaushik, Environmental Science and Engineering, New Age International, 3rd Edition, 2010.

REFERENCES

1. G. Tyler Miller Jr. and Scott Spoolman, Environmental Science, Brooks/Cole, 13th Edition, 2011.
2. Erach Bharucha, Text Book of Environmental Studies, Universities Press (India) Pvt. Ltd 2005.
3. R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standard", Vol. I and II, Enviro Media.
4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2nd edition, 2011.
5. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", Pearson Education, 3rd edition 2008.

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Course Designers:

S.No	Name of the Faculty	Email ID
1	Ms. B. Brindha	brindha@saveetha.ac.in
2	Dr. A. Saravanan	saravanana@saveetha.ac.in
3	Dr. S. Bharathi	bharathi@saveetha.ac.in

APPENDIX – I

Programme Outcomes

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutionsin societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and

write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX – II

PROGRAMME SPECIFIC OUTCOMES

DEPARTMENT : AGRICULTURAL ENGINEERING
1. To prepare an agricultural engineer to plan, design, modify, and direct the manufacture of agricultural machinery & implements for different agricultural production systems. 2. To inculcate the engineer with sound theoretical knowledge in engineering principles, sciences, research and in consultancy. 3. To impart positive and responsive out-reach attitudes, initiative and creative thinking in their mission as engineers

DEPARTMENT: BIOMEDICAL ENGINEERING
1. To design and develop diagnostic and therapeutic devices that reduces physician burnout and enhance the quality of life for the end user by applying fundamentals of Biomedical Engineering. 2. To apply software skills in developing algorithms for solving healthcare related problems in various fields of Medical sector. 3. To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions for current societal and scientific issues thereby developing indigenous medical instruments that are on par with the existing technology

DEPARTMENT: CIVIL ENGINEERING

1. To plan, design and execute high quality civil engineering projects by taking into account the economical, environmental, societal, health and safety factors involved in infrastructural development.
2. To involve in research and development that promotes sustainable solutions to real-world civil engineering problems and thereby promoting national infrastructural development.
3. To demonstrate profound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering, along with high proficiency in mathematics, basic sciences and technical communication.

DEPARTMENT: CHEMICAL ENGINEERING

1. Analyze process calculations, material & energy balances thermodynamics, unit operations & process control and evaluate chemical reaction engineering and transport processes.
2. Analyze process economics, project engineering safety and environment aspects and sustainable development to work in traditional and emerging chemical engineering areas.
3. Design equipment for chemical processing and analyze innovative Chemical processes.

DEPARTMENT: COMPUTER SCIENCE AND ENGINEERING

1. Professional Skills : Ability to identify the need of change in Computer Architecture, Data Organization, Algorithm, Data Analysis, Networking and Design Methodologies with focus on performance optimization.
2. Problem Solving Skills: Ability to develop optimal solutions for sub-problems with hardware and software products and integrate them in the domains like Data Analytics, Mobile Products, Networking, Web Systems and Embedded Systems in order to satisfy the specific requirements of current real-time problems.
3. Entrepreneurship Skills: Ability to use the technical expertise to establish new startups to provide products and services in the field of Information and Communication

Technology.

4. Research Skills: Ability to use the acquired knowledge in various domains to identify research gaps and hence to provide solutions with innovative ideas at par with the international standards.

DEPARTMENT: ELECTRONICS AND COMMUNICATION ENGINEERING

1. An ability to apply creativity in design and development of electronic circuits, equipments, systems.
2. An ability to apply existing hardware and software programming skills in real time.
3. An ability to comprehend and apply the knowledge of wired and wireless systems in the electronics and communication applications.

DEPARTMENT: INFORMATION TECHNOLOGY

1. To acquire knowledge to analyze, design and develop for providing technical solutions to real-world problems using current technologies.
2. To nurture a knack of entrepreneurship through IT knowledge and enhance the employability to meet economical necessities of the society.
3. To study future technologies through acquired knowledge and skills to diminish the research gaps.

DEPARTMENT: MEDICAL ELECTRONICS

1. To design and develop diagnostic and therapeutic devices those reduces physician turmoil and enhance the quality of life by applying fundamentals of Life sciences and Engineering for the society.
2. To apply hardware and software skills in developing algorithms for solving healthcare related problems in various fields of Medical sector.
3. To develop innovative medical devices by combining modern ideas of their core field and emerging technologies.

DEPARTMENT: ELECTRICAL AND ELECTRONICS ENGINEERING

1. The program must demonstrate that graduates possess the needed knowledge and competency in the fields of physics, chemistry and mathematics, to design, model and analyze electrical and electronics systems.
2. The program must demonstrate that graduates possess the knowledge and competency in application of electric circuit analysis, design of electrical and electronics systems, computer programming and use of associated software tools to design, simulate and analyze electrical and electronics systems.
3. The program must demonstrate that graduates can apply project management skills, by communicating effectively with team members as a leader or manager in the fields of electrical, electronics and computer science

DEPARTMENT: ELECTRONICS AND INSTRUMENTATION ENGINEERING

1. Apply the basic and advanced knowledge in the domain of Electronics & Instrumentation, for designing, developing, installing and maintaining equipment which is used to monitor and control systems, machinery and processes.
2. Apply the appropriate skills to solve problems and specific challenges in the field of Instrumentation such as advanced process control, PLC & SCADA, DCS, Artificial Intelligence and Machine Learning.
3. Apply the concepts of measurement and control techniques to create, setup and maintain various process based instruments used in Industries.

DEPARTMENT: MECHANICAL ENGINEERING

1. Design, analyze and evaluate mechanical components and systems, thermal systems including Internal Combustion (IC) engines, Turbo machinery, Refrigeration, Air conditioning and power generating systems using engineering design and analysis (EDA) tools.
2. Plan, quality assurance systems and process automation, manufacture of given mechanical components and systems.
3. Apply modern management methods to manufacture of components and systems.