MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

Hassan – 573202, Karnataka, India

Autonomous Programmes

BACHELOR OF ENGINEERING

DEPARTMENT OF CHEMISTRY

SYLLABUS
I AND II SEMESTERS
FIRST YEAR

Academic year 2025-26

Course Title	APPLIED CHEMISTRY FOR CIVIL ENGINEERING STREAM		
Course Code	CHE5C12/22	**(L-T-P)C**	(3-1-0)3
SEE duration	3 hour	**Hours / Week**	04
SEE marks	100	**Total contact hours**	90

Course Objective: The objective of this course is to build a strong foundation and basic skills in Engineering Chemistry for technological competence in industries.

Course Outcomes:
After the completion of the course, students shall be able to:-

Sl. No.	Course outcomes	Mapping to POs
1.	Describe the terms and chemical process involved in the scientific and engineering application.	PO1, PO2
2.	Illustrate the construction and working of the engineering process using basic concepts of chemistry.	PO1, PO2
3.	Outline the preparation, properties & applications associated with chemical substances in multidisciplinary fields.	PO1, PO2
4.	Apply the various principles and analytical techniques to solve the problems and quantitative analysis of materials in engineering applications.	PO1, PO2

Course Contents:

MODULE –1	10 Hrs.

Water and its Treatment

Introduction, sources of water, impurities in water, standards of water for industrial supply. Hardness of water, types of hardness determination of total hardness by EDTA method.

Boiler feed water and boiler problems, Boiler scales and sludge's- meaning, formation, disadvantages and prevention, priming and foaming.

External treatment of boiler feed water- Hot Lime -Soda process and Ion exchange method.

Internal treatment of water- phosphate conditioning & calgon treatment.

Desalination- Meaning, purification of water by reverse osmosis.

Potable water- Meaning, Standards of potable water, treatment of water for town supply**.** BOD and COD- definition, experimental determination of COD of the industrial waste water sample.

MODULE –2	10 Hrs.

Chemical Energy Sources and Engineering Materials

Fuels- Definition with examples. Characteristics of an ideal fuel. Calorific value- definition, types - Gross and Net calorific values, units in S.I system. Experimental determination of calorific value of a solid fuel using Bomb Calorimeter. Numerical problems on GCV and NCV.

Chemical processing of Petroleum: Cracking- Definition. Types of cracking- thermal and catalytic cracking. Fluidized catalytic cracking. Reforming of petrol with reactions (Isomerization, cyclisation, aromatization and dehydrogenation). Octane number &Cetane number. Knocking in IC engine. **Prevention of knocking** - Anti knocking agents (TEL & MTBE).

Green fuels: Power alcohol- introduction, advantages and disadvantages. B**iodiesel**- introduction, synthesis, advantages, and disadvantages.

Cement: Introduction, composition, properties, classification, manufacturing process of cement, process of setting and hardening of cement, additives for cement and testing of cement.

MODULE –3	10 Hrs.

Electrochemistry and Battery Technology

Introduction, electrochemical cells – Definition, Types of electrochemical cells, Construction, working & representation of galvanic cell. Modern sign conventions, single electrode potential, standard electrode potential. E.M.F of a cell, standard E.M.F of a cell, derivation of Nernst's equation.

Concentration cell- Definition with example, derivation of EMF of concentration cells.

Electrodes - Types of electrodes-Metal-metal ion electrode, Metal- metal salt ion electrode, gas-electrode and ion selective electrode.

Secondary reference electrodes – Calomel electrode-construction, working and applications.

Ion selective electrode- construction and working of glass electrode. Determination of pH of a solution using glass electrode. Numerical problems on E, E^0, E_{cell}, E^0_{cell} and concentration cells.

Potentiometric estimation of FAS using $K_2Cr_2O_7$ solution.

Battery technology

Batteries- Definition, classification of batteries- primary & secondary batteries.

Secondary batteries - construction, working and industrial applications of Lead- acid battery and Nickel-metal hydride battery.

Modern battery- construction, working and industrial applications of Li-ion batteries.

Fuel Cells- Introduction, definition, construction, working and industrial applications of H_2-O_2 fuel cell& Methanol-O_2 fuel cell.

MODULE – 4	10 hrs.

Macromolecules for Engineering Applications

Introduction, definition with examples. **Glass transition temperature (Tg) -** definition, factors affecting Tg and significances of Tg.

Plastics – Compounding of resins in to plastics.

Synthesis, properties and Industrial applications of PMMA and Polyurethane.

Polymer composites- introduction, **fibers-** meaning, synthesis, properties and industrial applications of Kevlar and Polyester.

Adhesives –Meaning, preparation, properties and applications of Epoxy resins & Phenol-formaldehyde resins.

Bio-degradable polymers- Introduction, types of bio-degradable polymers, preparation, properties and applications of polylactic acid (PLA).

Corrosion chemistry

Introduction, electrochemical theory of corrosion, types-differential metal, differential aeration (water line and pitting), factors affecting the nature of corrosion.

Corrosion control-galvanization, anodization and sacrificial anode method.

Prescribed Text Books:

Sl.No	BookTitle	Authors	Edition	Publisher	Year
1	Engineering Chemistry	M.M. Uppal	11th Edition	Khanna Publishers	2011
2	A text Book of Engineering Chemistry	P C Jain and Monica Jain	16th Edition	Dhanapatrai Publications	2015
3	A Text Book of Engineering Chemistry	R.V. Gadag and Nitthyananda Shetty	2nd Edition	I.K. International Publishing house	2016

4	Chemistry for Engineering Students	S. Jai Prakash, R. Venugopal, Sivakumaraiah & Pushpa Iyengar	5th Edition	Subash Publications	2014

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4	Instrumental Methods of Analysis	Dr. K. R. Mahadik and Dr. L. Sathiyanarayanan	1st Edition	Nirali Prakashan	2003
5	Text Book of Polymer Science	F.W. Billmeyer, John Wiley & Sons	4th Edition	John Wiley & Sons	1999
6	Vogels text book of quantitative inorganic analysis	J. Bassett, R.C. Denny, G.H. Jeffery	4th Edition	ELBS/Longman	1980

E Books and online course materials:

1. https://nptel.ac.in/courses/105105110 *(Water and Waste Water Engineering - NPTEL)*
2. https://onlinecourses.nptel.ac.in/noc23_ce42/preview *(Water Chemistry - NPTEL)*
3. https://www.kopykitab.com/Engineering-Chemistry *(Kopykitab - Various authors, eBook access)*
4. https://ndl.iitkgp.ac.in/result?q=engineering%20chemistry *(National Digital Library of India - Free access to Engineering Chemistry books)*
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Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Activities to be conducted.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**												
CO2	**3**	**2**												
CO3	**3**	**2**												
CO4	**2**	**3**												

Course Title	CHEMISTRY LAB FOR CIVIL ENGINEERING STREAM		
Course Code	CHE5CL17	**(L-T-P) C**	(0-0-2)1
Exam	3 hr	**Hours/Week**	02
SEE	50	**Total Hours**	**24**

Course Objective:
To provide students with practical knowledge of quantitative analysis of materials by volumetric and instrumental methods for the determination of constituents present in a sample.

Course Outcomes: Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Conducting the experiments with suitable volumetric and instrumental procedures.	PO1	-
2	Analysis and Estimation of materials using volumetric and instrumental methods.	PO2	-

SL. NO	Experiments
1	Estimation of total hardness of water by EDTA method.
2	Estimation of CaO in Portland cement.
3	Estimation of iron in TMT bar by biphenyl amine/external indicator method.
4	Estimation of Copper present in electroplating effluent by optical sensor.
5	Determination of Chemical Oxygen Demand (COD) of industrial waste water sample.
6	Determination of p^{Ka} of vinegar using p^{H} sensor.
7	Potentiometric estimation of FAS using $K_2Cr_2O_7$
8	Estimation of Copper present in electroplating effluent by optical sensor
9	Conductometric estimation of acid mixture
10	Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)
	Demonstration (any two) offline/virtual:
11	Synthesis of polymer
12	Synthesis of iron oxide nanoparticles
13	Chemical Structure drawing using software: ChemDraw or ACD/ChemSketch
14	Determination of chloride content in the given water sample by Argentometric method
	Open Ended Experiments:
15	Evaluation of acid content in beverages by using p^{H} sensors and simulation
16	Searching suitable PDB file and target for molecular docking

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Vogel's Textbook of Quantitative Inorganic Analysis	J. Bassett, R.C. Denny, G.H. Jeffery (Revised)	4th Edition	ELBS / Longman Group	1985
2	Applied Chemistry: Theory and Practice	O. P. Vermani, A. K. Narula	2nd Edition	New Age International	1992

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Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
Continuous Assessment	Conduction of experiments(continuous evaluation) -20 marks Reports -10 marks	30
Test (CIE)	Lab CIE	20
Total		**50**

Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1
CO1	3										
CO2		2									

Course Title	APPLIED CHEMISTRY FOR COMPUTER SCIENCE AND ENGINEERING STREAM		
Course Code	CHE5S12/22	**(L-T-P)C**	(3-1-0)3
SEE duration	3 hour	**Hours / Week**	04
SEE marks	100	**Total contact hours**	90

Course Objective: The objective of this course is to build a strong foundation and basic skills in Engineering Chemistry for technological competence in industries.

Course Outcomes:
After the completion of the course, students shall be able to:-

Sl. No.	Course outcomes	Mapping to POs
1.	Describe the terms and chemical process involved in the scientific and engineering application.	PO1, PO2
2.	Illustrate the construction and working of the engineering process using basic concepts of chemistry.	PO1, PO2
3.	Outline the preparation, properties & applications associated with chemical substances in multidisciplinary fields.	PO1, PO2
4.	Apply the various principles and analytical techniques to solve the problems and quantitative analysis of materials in engineering applications.	PO1, PO2

Course Contents:

MODULE –1	10 Hrs.

Macromolecules for Engineering Applications

Introduction, definition with examples. **Glass transition temperature (Tg)** - definition, factors affecting Tg and significances of Tg.

Plastics – Compounding of resins into plastics. Synthesis, properties and industrial applications of PMMA, Polyurethane & PTFE.

Polymer composites - introduction. **Fibers**- meaning, synthesis, properties and industrial applications of Kevlar and Polyester.

Adhesives –Meaning, preparation, properties and applications of Epoxy resins & Phenol-formaldehyde resins.

Bio-degradable polymers- Introduction, types of bio-degradable polymers, preparation, properties and applications of polylactic acid (PLA).

Elastomers- Definition, types-natural and synthetic rubber. Preparation of natural rubber from latex, deficiencies of natural rubber, vulcanization of natural rubber.

Synthetic rubbers- Preparation, properties and industrial applications of SBR rubber, Thiokol, and Silicon rubber**.**

MODULE –2	10 Hrs.

Electrochemistry and Sensors

Electrochemistry

Introduction, electrochemical cells – Definition, Types of electrochemical cells, Construction, working & representation of galvanic cell. Modern sign conventions, single electrode potential, standard electrode potential. E.M.F of a cell, standard E.M.F of a cell, derivation of Nernst's equation.

Concentration cell- Definition with example, derivation of E.M.F of concentration cells.

Electrodes -Types of electrodes-Metal-metal ion electrode, Metal- metal salt ion electrode, gas electrode and ion selective electrode.

Secondary reference electrodes – Calomel electrode- construction, working and applications.

Ion selective electrode- construction and working of the glass electrode. Determination of p^H of a solution using glass electrode. Numerical problems on E, E^0, E_{cell}, E^0_{cell} and concentration cells. Potentiometric estimation of FAS using $K_2Cr_2O_7$ solution.

Sensors: Introduction, working principle and applications of electrochemical sensors - Potentiometric sensors, Amperometric sensors, and Conductometric sensors. Optical sensors.

MODULE –3	**10 Hrs.**

Energy, Storage and Conversion

Batteries- Definition, difference between battery and cell. Classification of batteries- primary & secondary batteries. Battery characteristics.

Secondary batteries - construction, working and industrial applications of Lead- acid battery and Nickel-metal hydride battery.

Modern batteries: Construction, working and industrial applications of Li-ion battery.

Fuel Cells- Introduction, definition, construction, working and industrial applications of H_2-O_2 fuel cell & methanol-oxygen fuel cell. Differences between battery and fuel cell.

Green fuels: Power alcohol-introduction, advantages and disadvantages.

Biodiesel- Introduction, synthesis, advantages, and disadvantages.

E-waste management: Introduction, sources, types, effects of e-waste on environment and human health, methods of disposal, advantages of recycling, extraction of copper and gold from e-waste.

MODULE – 4	**10 hrs.**

Surface Finishing (PCB preparation)

Introduction, technological importance of metal finishing. Factors affecting the nature of electro deposit - metal ion concentration, current density, complexing agents, organic additives, p^H, temperature & throwing power.

Electroplating – Definition, electroplating process. Methods of cleaning the metal surfaces to be coated. Electroplating of Copper by cyanide bath method and electroplating of gold.

Electroless plating - Definition, distinction between electroplating and electroless plating, advantages of electroless plating. Electroless plating of Nickel and electroless plating of Copper in the manufacture of double-sided PCB.

Corrosion chemistry

Introduction, electrochemical theory of corrosion, types-differential metal, differential aeration (water line and pitting), factors affecting the nature of corrosion.

Corrosion control-galvanization, anodization and sacrificial anode method.

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CO1	**3**	**2**												
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CO4	**2**	**3**												

Course Title	CHEMISTRY LAB FOR COMPUTER SCIENCE ENGINEERING STREAM		
Course Code	CHE5SL17	**(L-T-P) C**	(0-0-2)1
Exam	3 hr	**Hours/Week**	02
SEE	50	**Total Hours**	**24**

Course Objective:
To provide students with practical knowledge of quantitative analysis of materials by volumetric and instrumental methods for the determination of constituents present in a sample.

Course Outcomes: Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Conducting the experiments with suitable volumetric and instrumental procedures.	PO1	-
2	Analysis and Estimation of materials using volumetric and instrumental methods.	PO2	-

SL. NO	Experiments
1	Estimation of total hardness of water by EDTA method.
2	Estimation of CaO in Portland cement.
3	Estimation of iron in TMT bar by biphenyl amine/external indicator method.
4	Estimation of Copper present in electroplating effluent by optical sensor.
5	Determination of Chemical Oxygen Demand (COD) of industrial waste water sample.
6	Determination of p^{Ka} of vinegar using p^{H} sensor.
7	Potentiometric estimation of FAS using $K_2Cr_2O_7$
8	Estimation of Copper present in electroplating effluent by optical sensor
9	Conductometric estimation of acid mixture
10	Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)
	Demonstration (any two) offline/virtual:
11	Synthesis of polymer
12	Synthesis of iron oxide nanoparticles
13	Chemical Structure drawing using software: ChemDraw or ACD/ChemSketch
14	Determination of chloride content in the given water sample by Argentometric method
	Open Ended Experiments:
15	Evaluation of acid content in beverages by using p^{H} sensors and simulation
16	Searching suitable PDB file and target for molecular docking

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Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
Continuous Assessment	Conduction of experiments(continuous evaluation) -20 marks Reports -10 marks	30
Test (CIE)	Lab CIE	20
Total		**50**

Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1
CO1	3										
CO2		2									

Course Title	APPLIED CHEMISTRY FOR ELECTRICAL AND ELECTRONICS ENGINEERING STREAM		
Course Code	CHE5E12/22	**(L-T-P)C**	(3-1-0)4
SEE duration	3 hour	**Hours / Week**	06
SEE marks	100	**Total contact hours**	90

Course Objective: The objective of this course is to build a strong foundation and basic skills in Engineering Chemistry for technological competence in industries.

Course Outcomes:
After the completion of the course, students shall be able to:-

Sl. No.	Course outcomes	Mapping to POs
1.	Describe the terms and chemical process involved in the scientific and engineering application.	PO1, PO2
2.	Illustrate the construction and working of the engineering process using basic concepts of chemistry.	PO1, PO2
3.	Outline the preparation, properties & applications associated with chemical substances in multidisciplinary fields.	PO1, PO2
4.	Apply the various principles and analytical techniques to solve the problems and quantitative analysis of materials in engineering applications.	PO1, PO2

Course Contents:

MODULE –1	10 Hrs.

Electrochemistry and Analytical Techniques

Electrochemistry- Introduction, electrochemical cells – Definition, Types of electrochemical cells, Construction, working & representation of galvanic cell. Modern sign conventions, single electrode potential, standard electrode potential. E.M.F of a cell, standard E.M.F of a cell, derivation of Nernst's equation.

Concentration cell- Definition with example, derivation of EMF of concentration cells.

Electrodes - Types of electrodes-Metal-metal ion electrode, Metal-metal salt ion electrode, gas- electrode and ion selective electrode.

Secondary reference electrode – Calomel electrode - construction, working and applications.

Ion selective electrode- construction and working of the glass electrode. Determination of p^H of a solution using glass electrode. Numerical problems on E, E^0, E_{cell}, E^0_{cell} and concentration cells.

Analytical techniques: Introduction, principle and instrumentation: Colorimetric sensors – estimation of copper, Potentiometric sensors – estimation of iron and Conductometric sensors – estimation of weak acid.

MODULE –2	10 Hrs.

Energy, Storage and Conversion

Batteries- Definition, difference between battery and cell. Classification of batteries – primary & secondary batteries. Battery characteristics.

Secondary batteries - construction, working and industrial applications of Lead- acid battery and Nickel-metal hydride battery.

Modern batteries: Construction, working and industrial applications of Li-ion battery.
Fuel Cells- Introduction, definition, construction, working and industrial applications of H_2-O_2 fuel cell & methanol-oxygen fuel cell. Differences between battery and fuel cells.
Green fuels:Power alcohol-Introduction, advantages and disadvantages. **Biodiesel**- Introduction, synthesis, advantages, and disadvantages.
E-waste management: Introduction, sources, types, effects of e-waste on environment and human health, methods of disposal, advantages of recycling, extraction of copper and gold from e-waste.

MODULE –3	**10 Hrs.**

Macromolecules for Engineering Applications

Introduction, definition with examples. **Glass transition temperature (Tg)** - definition, factors affecting Tg and significances of Tg.
Plastics – Compounding of resins into plastics. Synthesis, properties and industrial applications of PMMA, Polyurethane & PTFE.
Polymer composites- introduction**, Fibers**- meaning, synthesis, properties and industrial applications of Kevlar and Polyester.
Adhesives –Meaning, Preparation, properties and applications of Epoxy resins & Phenol-formaldehyde resins.
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Elastomers- Definition, types-natural and synthetic rubber. Preparation of natural rubber from latex, deficiencies of natural rubber, vulcanization of natural rubber.
Synthetic rubbers- Preparation, properties and industrial applications of SBR rubber, Thiokol,and Silicon rubber**.**

MODULE – 4	**10 hrs.**

Surface Finishing

Introduction, technological importance of metal finishing. Factors affecting the nature of electro deposit - metal ion concentration, current density, complexing agents, organic additives, p^H, temperature & throwing power.

Electroplating – Definition, electroplating process. Methods of cleaning the metal surfaces to be coated. Electroplating of Copper by cyanide bath method and electroplating of Gold.

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CO1	**3**	**2**												
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CO4	**2**	**3**												

Course Title	CHEMISTRY LAB FOR ELECTRICAL AND ELECTRONICS ENGINEERING STREAM		
Course Code	CHE5EL17	**(L-T-P) C**	(0-0-2)1
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SEE	50	**Total Hours**	**24**

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To provide students with practical knowledge of quantitative analysis of materials by volumetric and instrumental methods for the determination of constituents present in a sample.

Course Outcomes: Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Conducting the experiments with suitable volumetric and instrumental procedures.	PO1	-
2	Analysis and Estimation of materials using volumetric and instrumental methods.	PO2	-

SL. NO	Experiments
1	Estimation of total hardness of water by EDTA method.
2	Estimation of CaO in Portland cement.
3	Estimation of iron in TMT bar by biphenyl amine/external indicator method.
4	Estimation of Copper present in electroplating effluent by optical sensor.
5	Determination of Chemical Oxygen Demand (COD) of industrial waste water sample.
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8	Estimation of Copper present in electroplating effluent by optical sensor
9	Conductometric estimation of acid mixture
10	Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)
	Demonstration (any two) offline/virtual:
11	Synthesis of polymer
12	Synthesis of iron oxide nanoparticles
13	Chemical Structure drawing using software: ChemDraw or ACD/ChemSketch
14	Determination of chloride content in the given water sample by Argentometric method
	Open Ended Experiments:
15	Evaluation of acid content in beverages by using p^{H} sensors and simulation
16	Searching suitable PDB file and target for molecular docking

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Vogel's Textbook of Quantitative Inorganic Analysis	J. Bassett, R.C. Denny, G.H. Jeffery (Revised)	4th Edition	ELBS / Longman Group	1985
2	Applied Chemistry: Theory and Practice	O. P. Vermani, A. K. Narula	2nd Edition	New Age International	1992

Online Courses and Video Lectures:

https://nptel.ac.in/courses/104101090
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https://youtu.be/gDsGHYUHeBE?si=wxl7CP-q-28kzuyk

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
Continuous Assessment	Conduction of experiments(continuous evaluation) -20 marks Reports -10 marks	30
Test (CIE)	Lab CIE	20
Total		**50**

Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1
CO1	3										
CO2		2									

Course Title	APPLIED CHEMISTRY FOR MECHANICAL ENGINEERING STREAM		
Course Code	CHE5M12/22	**(L-T-P)C**	(3-1-0)4
SEE duration	3 hour	**Hours / Week**	04
SEE marks	100	**Total contact hours**	90

Course Objective: The objective of this course is to build a strong foundation and basic skills in Engineering Chemistry for technological competence in industries.

Course Outcomes:
After the completion of the course, students shall be able to:-

Sl. No.	Course outcomes	Mapping to POs
1.	Describe the terms and chemical process involved in the scientific and engineering application.	PO1, PO2
2.	Illustrate the construction and working of the engineering process using basic concepts of chemistry.	PO1, PO2
3.	Outline the preparation, properties & applications associated with chemical substances in multidisciplinary fields.	PO1, PO2
4.	Apply the various principles and analytical techniques to solve the problems and quantitative analysis of materials in engineering applications.	PO1, PO2

Course Contents:

MODULE –1	10 Hrs.

Chemical Energy Sources and Engineering materials

Fuels- Definition with examples. Characteristics of an ideal fuel. Calorific value- definition, types - Gross and Net calorific values, units in S.I system. Experimental determination of calorific value of a solid fuel using Bomb Calorimeter. Numerical problems on GCV and NCV.

Chemical processing of Petroleum: Cracking- Definition. Types of cracking- thermal and catalytic cracking. Fluidized catalytic cracking. Reforming of petrol with reactions (Isomerisation, cyclisation, aromatisation and dehydrogenation). Octane number & Cetane number. Knocking in IC engine. **Prevention of knocking** - anti knocking agents (TEL & MTBE).

Green fuels: Power alcohol- introduction, advantages and disadvantages. **Biodiesel**- introduction, synthesis, advantages and disadvantages.

Alloys: Introduction, classification, composition, properties and applications of Stainless Steel, Solders, Brass and Alnico.

MODULE –2	10 Hrs.

Water and its Treatment

Introduction, sources of water, impurities in water, standards of water for industrial supply. Hardness of water, types of hardness determination of total hardness by EDTA method.

Boiler feed water and boiler problems, Boiler scales and sludges- meaning, formation, disadvantages and prevention, priming and foaming.

External treatment of boiler feed water- Hot Lime -Soda process and Ion exchange method.

Internal treatment of water- phosphate conditioning & Calgon treatment.

Desalination- Meaning, purification of water by reverse osmosis.

Potable water- Meaning, Standards of potable water, treatment of water for town supply**.**

BOD and COD- definition, experimental determination of COD of the industrial waste water sample.

MODULE –3	10 Hrs.

Electrochemistry and Battery Technology

Introduction, electrochemical cells – Definition, Types of electrochemical cells, Construction, working & representation of galvanic cell. Modern sign conventions, single electrode potential, standard electrode potential. E.M.F of a cell, standard E.M.F of a cell, derivation of Nernst equation.

Concentration cell- Definition with example, derivation of EMF of concentration cells.

Electrodes - Types of electrodes-Metal-metal ion electrode, Metal- metal salt ion electrode, gas-electrode and ion selective electrode.

Secondary reference electrodes – calomel electrode-construction, working and applications.

Ion-selective electrode- construction and working of glass electrode. Determination of pH of a solution using glass electrode. Numerical problems on E, E^0, E_{cell}, E^0_{cell} and concentration cells.

Potentiometric estimation of FAS using $K_2Cr_2O_7$ solution.

Battery technology

Batteries- Definition, Classification of batteries- primary & secondary batteries.

Secondary batteries - construction, working and industrial applications of Lead- acid battery and Nickel - metal hydride battery.

Modern battery- construction, working and industrial applications of Li-ion batteries.

Fuel Cells- Introduction, definition, construction, working and industrial applications of H_2-O_2 fuel cell & Methanol-O_2 fuel cell.

MODULE –4	10 Hrs

Macromolecules for Engineering applications

Introduction, definition with examples. **Glass transition temperature (Tg) -** definition, factors affecting Tg and significances of Tg.

Plastics – Compounding of resins in to plastics.

Synthesis, properties and Industrial applications of PMMA and Polyurethane.

Polymer composites- introduction, **fibers**- meaning, synthesis, properties and industrial applications of Kevlar and polyester.

Adhesives –Meaning, Preparation, properties and applications of Epoxy resins & Phenol-formaldehyde resins.

Bio-degradable polymers- Introduction, types of bio-degradable polymers, preparation, properties and applications of polylactic acid (PLA).

Corrosion chemistry

Introduction, electrochemical theory of corrosion, types-differential metal, differential aeration(water line and pitting), factors affecting the nature of corrosion.

Corrosion control-galvanization, anodization and sacrificial anode method.

Prescribed Text Books:

Sl.No	BookTitle	Authors	Edition	Publisher	Year
1	Engineering Chemistry	M.M. Uppal	11th Edition	Khanna Publishers	
2	A text Book of Engineering Chemistry	P C Jain and Monica Jain	16th Edition	Dhanapatrai Publications	2015
3	A Text Book of Engineering Chemistry	R.V. Gadag and Nitthyananda Shetty	2nd Edition	I.K. International Publishing house	2016
4	Chemistry for Engineering Students	S. Jai Prakash, R. Venugopal, Sivakumaraiah & Pushpa Iyengar	5th Edition	Subash Publications	2014

Reference Books:

Sl.No	BookTitle	Authors	Edition	Publisher	Year
1	Industrial Chemistry	B.K.Sharma	34 Edition	GOEL Publishing House	2014
2	Industrial Electrochemistry	Derek Pletcher & Frank C	2nd Edition	Walsh publisher	1993
3	Corrosion Engineering	M.G. Fontana, N.D. Greene	3rd Edition	McGraw Hill Publications	1996
4	Instrumental Methods of Analysis	Dr. K. R. Mahadik and Dr. L. Sathiyanarayanan	1st Edition	Nirali Prakashan	2003
5	Text Book of Polymer Science	F.W. Billmeyer, John Wiley & Sons	4th Edition	John Wiley & Sons	1999
6	Vogels text book of quantitative inorganic analysis	J. Bassett, R.C. Denny, G.H. Jeffery	4th Edition	ELBS/Longman	1980

E Books and online course materials:

1. **https://_** https://nptel.ac.in/courses/105105110 *(Water and Waste Water Engineering - NPTEL)*
2. https://onlinecourses.nptel.ac.in/noc23_ce42/preview *(Water Chemistry - NPTEL)*
3. https://www.kopykitab.com/Engineering-Chemistry *(Kopykitab - Various authors, eBook access)*
4. https://ndl.iitkgp.ac.in/result?q=engineering%20chemistry *(National Digital Library of India - Free access to Engineering Chemistry books)*
5. https://www.pdfdrive.com/engineering-chemistry-books.html *(PDFDrive - Free Engineering Chemistry PDFs*

Online Courses and Video Lectures:

1. https://www.edx.org/course/chemistry *(Introductory Chemistry - edX platform)*
2. https://www.youtube.com/playlist?list=PLLy_2iUCG87CQhELCytYLzKfBkzU8ovN9 *(NPTEL Engineering Chemistry Video Lectures - YouTube)*

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Activities to be conducted.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes[POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	**3**	**2**												
CO2	**3**	**2**												
CO3	**3**	**2**												
CO4	**2**	**3**												

Course Title	CHEMISTRY LAB FOR MECHANICAL ENGINEERING STREAM		
Course Code	CHE5ML17	**(L-T-P) C**	(0-0-2)1
Exam	3 hr	**Hours/Week**	02
SEE	50	**Total Hours**	**24**

Course Objective:
To provide students with practical knowledge of quantitative analysis of materials by volumetric and instrumental methods for the determination of constituents present in a sample.

Course Outcomes: Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Conducting the experiments with suitable volumetric and instrumental procedures.	PO1	-
2	Analysis and Estimation of materials using volumetric and instrumental methods.	PO2	-

SL. NO	Experiments
1	Estimation of total hardness of water by EDTA method.
2	Estimation of CaO in Portland cement.
3	Estimation of iron in TMT bar by biphenyl amine/external indicator method.
4	Estimation of Copper present in electroplating effluent by optical sensor.
5	Determination of Chemical Oxygen Demand (COD) of industrial waste water sample.
6	Determination of p^{Ka} of vinegar using p^{H} sensor.
7	Potentiometric estimation of FAS using $K_2Cr_2O_7$
8	Estimation of Copper present in electroplating effluent by optical sensor
9	Conductometric estimation of acid mixture
10	Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)
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