Course Code		:	1BCHS102C/202C	**Applied Chemistry for Computer Science Engineering Stream**	Semester	:	II
L:T:P		:	3:0:2		Course Type	:	Integrated
Hours/Sem.	Teaching	:	42 + 26 Hrs		CIE Marks	:	50
	Learning(W+SL)	:	44 Hrs		SEE Marks	:	50
	Exam	:	05 + 03Hrs		Total Marks	:	100
	Total Hrs.	:	120 Hrs		Credits	:	04

Professional Competency:

Students Able to analyze and apply the knowledge of advanced materials to modern computing hardware, smart and energy-efficient systems.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Analyse the display systems and advanced battery systems.

CO2: Analyze quantum materials, conducting polymers and their roles in energy and electronic systems.

CO3: Evaluate the need of green materials in sustainable electronics and e-waste management.

CO4: Apply concepts of sensors and corrosion control in engineering applications.

UNIT-I Display systems and Advanced Battery systems	**11 Hrs.**

Display systems: Definition of optoelectronic devices. Photoactive materials-definition and working principles in display system. Electroactive materials; definition and working principles in display systems. Light Emitting Diode (LED): Introduction, construction, working and application of Light emitting diode (LED). Organic Light Emitting Diode (OLED): Introduction, anatomy of OLED, types of OLED, comparison between LED and OLED, advantages, disadvantages of OLED and applications of OLED. Quantum Light Emitting Diodes (QLED's); Properties and applications. Light emitting electrochemical cells- Introduction, properties and applications.

Advanced Battery Chemistry: Introduction, electrode potential. Concentration cell and numerical problems. Classification of batteries, characteristics of battery: voltage, capacity, power density, shelf life and cycle life. Construction, working and applications of sodium ion battery and lithium ion battery. Construction, working and applications of ultra-small asymmetric super capacitor in IoT/ wearable devices. Construction and working of redox flow battery and its applications.

UNIT–II Quantum Dot materials and Polymer	**10Hrs.**

Quantum Dot materials: Introduction to Quantum Dots (QDs), types, optical and electrical properties of quantum dots (QDs). In-organic Quantum Dot materials (OQDMs): Introduction, synthesis and properties of silicon based QDs by Sol-Gel Method and CdSe quantum dots by hot injection method and applications in optoelectronic devices. Quantum Dot-based Copper Conductive Ink by Wet chemical reduction method, properties and applications.

Polymer: Introduction, molecular weight of polymers - number and weight average molecular weight of polymers, numerical problems. Structure-property relationship of polymers, synthesis, properties of nylon-12 and advantages in 3D printing applications. Synthesis and properties of PVC and PMMA for device applications. Conducting polymers-Introduction, synthesis of polyacetylene. Conduction mechanism of poly acetylene (n and p type) and its engineering applications.

UNIT–III Green Materials and E-Waste Management	**11 Hrs.**

Green Chemistry: Introduction, principles of green chemistry, properties and applications of green solvents for server heat management, biosynthesis and properties of glycerol trioleate ester for server and IT infrastructure applications. Green synthesis of ZnO nanoparticles for magnetic radio frequency identification (RFID) & Internet of Nano Things (IONT) system applications.

Biomaterials: Introduction, synthesis and properties of poly lactic acid (PLA) and polyethylene glycol (PEG) for touch screen applications. Synthesis and properties of alginate hydrogel for Brain-Computer

Interfaces (BCIs) applications.

E-waste: Introduction, sources, composition of e-waste, effects of e-waste on environment and Human Health. Artificial intelligence in e-waste management and its applications, extraction of Gold from e-waste by bioleaching method, direct recycling method of lithium-ion batteries. Role of stake holders in environmental management of e-waste (producers, consumers, recyclers, statutory and bodies).

UNIT–IV Sensing methods and Corrosion Control	**10 Hrs.**

Sensing methods: Sensors, Working principle, Colorimetric sensors- Principle, instrumentation and its application in the estimation of copper in PCBs. Potentiometric sensors-Principle, instrumentation and its application in the estimation of iron in steel. Conductometric sensors- Principle, instrumentation and its application in the estimation of acid mixture. pH sensor its applications in the estimation of pH of soil sample.

Corrosion: Introduction, electrochemical theory of corrosion, types of corrosion-differential metal and differential aeration corrosion, Factors affecting the rate of corrosion. Corrosion control-Galvanization, anodization, Cathodic protection by sacrificial anodic method, vapour corrosion inhibitors for protecting computer circuit boards, corrosion penetration rate (CPR)-definition, importance and numerical on CPR.

Practical Module

1. Estimation of strength of acid in lead acid battery.
2. Determination of alkalinity of given boiler water sample.
3. Estimation of iron in TMT bar by diphenyl amine indicator method.
4. Estimation of total hardness of water by EDTA method.
5. Estimation of percentage of CaO in cement.
6. Estimation of acid mixture by conductometric sensor.
7. Estimation of iron in rust sample by Potentiometric sensor.
8. Determination of pKa of vinegar using pH sensor.
9. Colorimetric estimation of copper present in e-waste by optical sensor.
10. Determination of coefficient of viscosity of a lubricant by Ostwald's viscometer.
11. Data analysis of pKa of a week acid and its interpretation using origin software.
12. Chemical structure drawing using software: Chem Draw/Chem Sketch.

Text Books:

1. R. V. Gadag and Nityananda Shetty, A Text Book of Engineering Chemistry, I. K. International Publishing house. 2nd Edition, 2016.
2. Dr. Mahesh B and Dr. Roopashree B, Engineering Chemistry, Publisher Sunstar Bengaluru, ISBN978-93-85155-70-3, 1st Edition, 2022.
3. Dr. K. R. Mahadik & Dr. L. Sathyanarayanan, Instrumental Methods of Analysis, Nirali Prakashan, 1st Edition, 2020.
4. V. R. Gowariker,N V Viswanathan, Jayadev, Sreedhar, Polymer Science, New age Int. Publishers, 4th Edition, 2021.
5. Douglas A. Skoog, F. James Holler, Stanley R., Principles of Instrumental Analysis, Cengage Learning Crouch 7th Edition, 2020.

Reference Books:

1. Wiley Engineeering Chemistry, Wiley India Pvt.Ltd.,,ISBN-978-81-265-47205, 5th Edition 2019
2. Kirby W. Beard, Linden's Hand book of Batteries, Mc Graw Hill, 5th Edition, 2019.
2. Takatoshi Tsujimura, OLED Display Fundamentals and Applications, Wiley–Blackwell, 2012.
3. F.H.Froes, etal. High Performance Metallic Materials for Cost Sensitive Applications John, Wiley & Sons, 2010.
4. PC Jain & Monica Jain, Engineering Chemistry, Dhanpat Rai Publication, 6th Edition. 2015.
5. Hari Singh, Nano structured materials and nanotechnology, Nalwa, Academic press, 1st Edition,2002
6. Sulabha K Kulkarni, Nanotechnology Principles and Practices, Capital Publishing Co., 3rd Edn.2014.

7. Phanikumar, Principles of nano technology, Sci Tech publications, 2nd Edition, 2010.
8. B.S. Jai Prakash, R. Venugopal, Sivakumaraiah & Pushpa Iyengar. Chemistry for Engineering Students, Subash Publications, 5th Edition, 2014.
9. O.G.Palanna, Engineering Chemistry, Tata Mc. Graw Hill Education Pvt. Ltd. New Delhi, 4th Reprint, 2015.
10. Malini S KS Anantha Raju, Chemistry of Engineering materials, CBS publishers Pvt. Ltd. 1st Edition 2022
11. Anupma Rajput, Laboratory Manual Engg. Chemistry, Dhanpat Rai & Co.
12. Dr. S.S. Dhara and Dr. S.S. Umare, "A Text book of Engineering Chemistry" S.Chand & Co., Ltd., ISBN-81-219-0359-9, 12th Edition 2011.

Web Links and Video Lectures:

1. https://share.google/LtpHOOUap66I6NwOV
2. https://share.google/QwXas6NSPc0of6zM9
3. https://share.google/ERD47wgd8C01N0yX4
4. https://share.google/CCs0ZW05ZZ2UqoMWx
5. https://share.google/1mGdeQfw5cC1Mf6VM
6. https://share.google/puIX4PlD66rLXHyVL
7. https://share.google/s80xVHUdermr8iWbQ
8. https://share.google/CvfPaREV6ML3FuNLP
9. https://share.google/xcq5qgLDkw1FUzfBQ
10. https://share.google/4yT2LLms6onWX21Up
11. https://share.google/FJdSn0UcT7ft4W7lF
12. https://share.google/jw5PdB5k0c0IlQATa
13. https://www.scribd.com/document/438268216/Engineering-Chemistry-Notes-For-vtu-stud-pdf

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 WK1, WK2, WK3,	2 WK1, WK3									1	-	-	-
CO2	3 WK1, WK2, WK3,	2 WK1, WK2, WK3									1	-	-	-
CO3	3 WK1, WK2, WK3,	2 WK1, WK3,									1	-	-	-
CO4	3 WK1, WK2, WK3,	2 WK1, WK2, WK3,									1	-	-	-

Note: All knowledge profile elements (WKs) mapped to a particular Program Outcome (PO) may not necessarily be addressed by all Course Outcomes (COs) of a course. For example, PO5 is addressed through CO2 and CO3 primarily using WK6, even though WK2 is also associated with PO5 at the program level. However, WK2 is not addressed by these COs in this course.

Course Code		**:**	**1BCHC102C/202C**	**Applied Chemistry for Civil Engineering Stream**	**Semester**	**:**	**I/II**
L:T:P		**:**	**3:0:2**		**Course Type**	**:**	**Integrated**
Hours/Sem.	**Teaching**	**:**	**42+26 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**44 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**05 + 03 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**120 Hrs**		**Credits**	**:**	**04**

Professional Competency:

Analyse and choose bulk/nano materials for the production of finished products for societal applications.

Course Outcomes:

At the end of the course the student will be able to:

CO1: Analyze water quality parameters and extent of water pollution.

CO2: Use polymers, nanomaterials and composite materials for structural integrity.

CO3: Evaluate sustainable construction materials like cement, geo polymer concrete, biopolymers and piezoelectric composites.

CO4: Apply corrosion control methods for metals and analytical techniques for industrial effluents.

UNIT – I Water chemistry and Water pollution — 11Hrs.

Water Chemistry: Introduction, Potable water, Standards of potable water, Significance of water quality parameters; pH, turbidity, chlorides, dissolved oxygen and alkalinity for environmental and construction applications. Hardness of water; types, determination of total hardness by EDTA method, numericals on hardness of water. Determination of chloride by Mohr's method. Softening of water by ion exchange and electrodialysis.

Water pollution: Sources, Sewage, aerobic and anaerobic oxidation, Sewage treatment, Primary, Secondary (Activated sludge process) and Tertiary treatment. Determination of dissolved oxygen by Winkler's method, Determination of Biological oxygen demand and numericals on BOD. Determination of Chemical oxygen demand and numericals on COD.

UNIT – II Polymer and Nanomaterials — 10Hrs.

Polymer: Introduction, polymerization, types, synthesis, properties and engineering applications of PVC, PMMA, Kevlar fiber and epoxy resins. Molecular weight of polymers: number average and weight average molecular weight of polymers, numericals on Mn & Mw. Properties and industrial applications of carbon-based reinforced composites-graphene/carbon nano-tubes as fillers. Conducting Polymer: Definition, Synthesis of polyacetylene. Conducting mechanism of Polyacetylene (n & p type) and applications.

Nanomaterials: Introduction, classification, size dependent properties *viz*; surface area, water absorption, permeability, thermal properties and antimicrobial activity, synthetic route (Bottom up and Top down approaches), synthesis of nanomaterials by sol-gel method and laser ablation method. Nano scale materials: Silica fumes, GGBS, Fly ash and rice husk ash their compositions and applications.

UNIT – III Conventional and Sustainable Construction Materials — 11 Hrs.

Cement: Introduction, composition, manufacturing process of cement by dry process, process of setting and hardening of cement, special cements-composition, properties and applications. Geopolymer Concrete–Introduction, mechanism of geopolymerization and manufacturing process of geopolymer concrete. Biopolymers – Poly lactic Acid (PLA) and Poly hydroxyl butyrate (PHB) – synthesis, properties and applications.

Metals and Alloys: Introduction, classification of metal alloys: ferrous and non-ferrous, composition, properties, applications of iron and its alloys in civil engineering.
Piezoelectric Cement Composites: Introduction, piezoelectric materials in cement composites and its applications in civil engineering.

UNIT – IV Corrosion Science and Analytical Techniques	10 Hrs.

Corrosion: Introduction, electrochemical corrosion of steel in concrete, types- differential metal corrosion and differential aeration corrosion, stress corrosion in civil structures. Factors affecting the rate of corrosion. Corrosion control: Metallic coating-galvanization. Surface conversion coating: anodizing. Cathodic protection: Sacrificial anodic protection. Corrosion inhibitors. Corrosion penetration rate (CPR) - definition, importance and numericals on CPR.

Analytical Techniques: Sensors**:** Introduction, working principle**.** Applications of sensor in the detection of fire, cracks, metals. Potentiometric sensors: principle, instrumentation and application in estimation of iron in industrial effluents. Conductometric sensors: principle, instrumentation and application in determination of acid mixture in industrial effluents. pH sensor: Estimation of pH of soil sample.

Practical Module

1. Estimation of strength of acid in lead acid battery.
2. Determination of alkalinity of given boiler water sample.
3. Estimation of iron in TMT bar by diphenyl amine indicator method
4. Estimation of total hardness of water by EDTA method.
5. Estimation of percentage of CaO in cement.
6. Estimation of acid mixture by conductometric sensor.
7. Determination of pKa of vinegar using pH sensor.
8. Estimation of iron in rust sample by Potentiometric sensor.
9. Colorimetric estimation of copper present in e-waste by optical sensor.
10. Determination of coefficient of viscosity of a lubricant by Ostwald's viscometer.
11. Data analysis of pKa of a week acid and its interpretation using origin software.
12. Chemical structure drawing using software: Chem Draw/ Chem Sketch.

Text Books:

1. Dr. Suba Ramesh etal. "Wiley Engineering Chemistry", Wiley India Pvt. Ltd. New Delhi, 2nd Edition, 2018.
2. S.S. Dara etal, "A Text book of Engineering Chemistry", S. Chand Pub Pvt. Ltd., New Delhi, 12th Edition, 2011.
3. R.V. Gadag and Nityananda Shetty, "A Text Book of Engineering Chemistry", I. K. International Publishing house, New Delhi, 2nd Edition, 2016.

Reference Books:

1. B. S. Murthy etal., "Text book of Nano science and Technology", University press Pvt. Ltd., Hyderabad, 1st Edition, 2021.
2. M. S. Ramachandra etal., "Nano science and Technology", Wiley India Ltd., Publisher, 1st Edition 2017.
3. Premamoy Ghosh "Polymer Science and Technology" Tata Mc. Grow Hill Pvt., New Delhi, 3rd Edition 2011.
4. Dr. B. C. Punima, etal., "Building constructions", Laxmi Publications Pvt. Ltd., New Delhi, 12th Edition 2025.
5. S. S. Bevinakatti, Building Materials", Vikas Publishing/S. Chand imprint, India, 1st Edition, 2012.

Web Link and Video Lectures:

Web Links

1. https://share.google/osn5hvgxQ2HLcp018
2. https://share.google/2wsHfWUo988WwQ8Wf
3. https://share.google/RhB4pd8GzoZ10zXXP
4. https://share.google/K6DvK716X16dj9djZ

Video Links

- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=j5Hml6KN4TI
- https://www.youtube.com/watch?v=1xWBPZnEJk8
- https://www.youtube.com/watch?v=wRAo-M8xBHM

Activity Based Learning (Suggested Activities in Class)/Practical Based learning

- https://www.vlab.co.in/broad-area-chemical-sciences
- https://interestingengineering.com/science

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 WK1 WK2 WK3	2 WK1, WK2 WK3									1	-	-
CO2	3 WK1 WK2 WK3	2 WK1 WK2 WK3									1	-	-
CO3	3 WK1 WK2 WK3	2 WK1 WK2 WK3									1	-	-
CO4	3 WK1 WK3	2 WK1 WK3									1	-	-
CO5	3 WK1 WK3	2 WK1 WK3									1	-	-

Note: All knowledge profile elements (WKs) mapped to a particular Program Outcome (PO) may not necessarily be addressed by all Course Outcomes (COs) of a course.

For example, PO5 is addressed through CO2 and CO3 primarily using WK6, even though WK2 is also associated with PO5 at the program level. However, WK2 is not addressed by these COs in this course

Course Code		:	1BCHE102C/202C	**Applied Chemistry for Electrical & Electronics Engineering Stream**	Semester	:	I/II
L:T:P		:	3:0:2		Course Type	:	Integrated
Hours/Sem.	Teaching	:	42+26 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	44 Hrs		SEE Marks	:	50
	Exam	:	05+03 Hrs		Total Marks	:	100
	Total Hrs.	:	120 Hrs		Credits	:	04

Professional Competency:

Graduate will processes the professional competency to apply fundamental, chemical sciences, analytical problem solving skills and engineering reasoning to design, evaluate and improve chemical processes and technologies responsibly and efficiently across diverse engineering domains.

Course Outcomes:

After completion of the course student will be able to;

CO1: Analyse the functioning of electrode system, energy storage and conversion systems.

CO2: Identify the synthesis, properties of nanomaterials and quantum dots in day today Applications.

CO3: Solve corrosion in metals, apply metal finishing methods for surface protection and material recovery from e-waste for environmental safety.

CO4: Apply basic principles of sensors and role of functional polymers and composites in flexible electronic applications.

UNIT-I Electrode system and Energy Devices	**11Hrs.**

Electrode System: Introduction, types of electrodes, reference electrode, construction, working and applications of calomel electrode. Ion selective electrode – definition. Construction and working of glass electrode, determination of pH using glass electrode. Construction and working of concentration cell and numericals on concentration cell.

Energy storage devices: Introduction, classification of batteries- primary, secondary and reserve battery, characteristics (voltage, capacity, power density, shelf life & cycle life). Construction, working and EV applications of lithium-ion battery and sodium-ion battery. Energy conversion devices: Introduction, construction, working principle, advantages and applications of photovoltaic cell (PV cell).

UNIT–II Nanomaterials and Quantum Dot Materials	**10Hrs.**

Nanomaterials: Introduction, classification, size dependent properties of nanomaterials (Surface area, Catalytic, Electrical, Magnetic, Mechanical and Optical). Synthesis of nanoparticles by sol-gel method and CVD method with example, (Show the nanoparticals using images). Nano scale materials: Nano clusters, Nano wire, Carbon nanotubes and their applications.

Quantum Dot materials: Introduction to Quantum Dots, Types. Inorganic Quantum Dot materials (IQDMs) – Introduction. Synthesis and properties of silicon based QDs by Sol-Gel Method and CdSe quantum dots by hot injection method and applications in optoelectronic devices. Quantum Dot -based Copper Conductive Ink by wet chemical reduction method, properties and applications.

UNIT–III Corrosion Chemistry and E-Waste management	**11 Hrs.**

Corrosion Chemistry: Introduction, electrochemical theory of corrosion, types of electrochemical corrosion, differential metal (electronic circuits) and differential aeration (waterline and pitting). Factors affecting rate of corrosion. Corrosion control-galvanization and anodization. Cathodic protection: sacrificial anodic method. Corrosion Penetration Rate (CPR) - Introduction and numericals on CPR (unit in mm/year).

Metal finishing: Introduction, technological importance of metal finishing. Electroplating-definition, Electroplating of chromium for hard and decorative coatings. Electroless plating-definition, Electroless plating of copper on PCBs.

E-waste Management: Introduction, sources, composition of e-waste, effects of e-waste on environment and human health. Methods of disposal of e-waste, recycling of e-waste. Extraction of gold from e-waste. Role of stack holders in e-waste management.

UNIT–IV Sensing methods and Polymer materials	**10 Hrs.**

Sensing Methods: Sensors, working principle, types of sensors(Optical, Electrochemical & their applications in real life). Colorimetric sensors- Principle, instrumentation and its application in the estimation of copper in PCBs. Potentiometric sensors-Principle, instrumentation and its application in the estimation of iron in steel. Conductometric sensors- Principle, instrumentation and its application in the estimation of acid mixture.

Polymers: Introduction, synthesis, conduction mechanism of polyacetylene (n & p type) and electronic devices applications. Number average and weight average molecular weight and numericals on $\overline{Mn}$ and $\overline{Mw}$. Synthesis and properties of Polydimethylsiloxane (PDMS) in RFID (Radio Frequency Identification) applications. Synthesis and properties of Polyvinylidene Fluoride (PVDF), applications in E-nose devices. Polymer Composites**:** Introduction, synthesis and properties of epoxy resin- Fe_3O_4 composite for sensors applications, synthesis of Kevlar Fiber Reinforced Polymer (KFRP)-properties and smart electronic devices applications.

Practical Module

1. Estimation of strength of acid in lead acid battery.
2. Determination of alkalinity of given boiler water sample.
3. Estimation of iron in TMT bar by diphenyl amine indicator method.
4. Estimation of total hardness of water by EDTA method.
5. Estimation of percentage of CaO in cement.
6. Estimation of acid mixture by conductometric sensor.
7. Determination of pKa of vinegar using pH sensor.
8. Estimation of iron in rust sample by Potentiometric sensor.
9. Colorimetric estimation of copper present in e-waste by optical sensor.
10. Determination of coefficient of viscosity of a lubricant by Ostwald's viscometer.
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12. Chemical structure drawing using software: Chem Draw/ Chem Sketch.

Text Books:

1. R. V. Gadag and Nityananda Shetty, A Text Book of Engineering Chemistry, I. K. International Publishing house. 2nd Edition, 2016.
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3. Dr. K. R. Mahadik & Dr. L. Sathiyanarayanan, Instrumental Methods of Analysis, Nirali Prakashan, 2nd Edition, 2023.
4. V R Gowariker, N V Viswanathan, Jayadev, Sreedhar, Polymer Science, New age Int. Publishers 4th Edition, 2021.
5. Douglas A. Skoog, F. James Holler, Stanley R., Principles of Instrumental Analysis, Cengage Learning Crouch 7th Edition, 2020.

Reference Books:

1. Wiley Engineering Chemistry, Wiley India Pvt.Ltd.,,ISBN-978-81-265-47205, 5th Edition 2019
2. Kirby W. Beard, Linden's Hand book of Batteries , Mc Graw Hill, 5th Edition,2019.
2. Takatoshi Tsujimura, OLED Display Fundamentals and Applications, Wiley–Blackwell, 1st Edition 2012
3. F.H.Froes, etal. High Performance Metallic Materials for Cost Sensitive Applications John, Wiley & Sons, 2010
4. PC Jain & MonicaJain, Engineering Chemistry, Dhanpat Rai Publication, 6th Edition. 2015

5. Hari Singh, Nano structured materials and nanotechnology, Nalwa, academic press, 1st Edition, 2002.
6. Sulabha K Kulkarni, Nanotechnology Principles and Practices, Capital Publishing Company, 3rd Edition 2014
7. Phanikumar, Principles of nano technology, Sci Tech publications, 2nd Edition, 2010.
8. B.S. Jai Prakash, R. Venugopal, Sivakumaraiah & Pushpa Iyengar. Chemistry for Engineering Students, Subash Publications,5th Edition, 2014
9. O.G.Palanna, Engineering Chemistry, Tata Mc Graw Hill Education Pvt. Ltd. New Delhi, 4th Reprint, 2015.
10. Malini S, KS Anantha Raju, Chemistry of Engineering materials, CBS publishers Pvt., Ltd., New Delhi,1st Edition, 2022.
11. Anupma Rajput, Laboratory Manual Engg. Chemistry, Dhanpat Rai & Co., New Delhi, 1st Edition, 2022.
12. Dr. S.S. Dhara and Dr. S.S. Umare, "A Text book of Engineering Chemistry" S.Chand & Co., Ltd., New Delhi., ISBN- 81-219-0359-9, 12th Edition 2011.

Web Links and Video Lectures

1. https://share.google/aVVplsAOe1orXXpim
2. https://share.google/QwXas6NSPc0of6zM9
3. https://share.google/ERD47wgd8C01N0yX4
4. https://share.google/CCs0ZW05ZZ2UqoMWx
5. https://share.google/1mGdeQfw5cC1Mf6VM
6. https://share.google/puIX4PlD66rLXHyVL
7. https://share.google/FJdSn0UcT7ft4W7lF
8. https://share.google/jw5PdB5k0c0IlQATa
9. https://share.google/1jBk456vAZqjq2L7d

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11			
CO1	3 WK1, WK2, WK3,	2 WK1, WK2, WK3									1			
CO2	3 WK1, WK2, WK3,	2 WK1, WK3									1			
CO3	3 WK1, WK2, WK3,	2 WK1, WK2, WK3									1			
CO4	3 WK1, WK2, WK3,	2 WK1, WK2, WK3									1			

Note: All knowledge profile elements (WKs) mapped to a particular Program Outcome (PO) may not necessarily be addressed by all Course Outcomes (COs) of a course. For example, PO5 is addressed through CO2 and CO3 primarily using WK6, even though WK2 is also associated with PO5 at the program level. However, WK2 is not addressed by these COs in this course

Course Code		**:**	**1BCHM102C/202C**	**Applied Chemistry for Mechanical Engineering Stream**	**Semester**	**:**	**I**
L:T:P		**:**	**3:0:2:0**		**Course Type**	**:**	**Integrated**
Hours/Sem.	**Teaching**	**:**	**42+26 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**44 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**05 + 03 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**120 Hrs**		**Credits**	**:**	**04**

Professional Competency:

Proficiency in analyzing electro-analytical techniques to assess material performance, reliability, and durability.

Course Outcomes:

After completion of the course student will be able to;

CO1: Identify the existing and future fuels for conservative approach.

CO2: Apply current and futuristic energy sources and devices for energy storage.

CO3: Analyse the electro analytical processes that evaluate the performance and durability of materials.

CO4: Determine the various properties of materials and processing technologies for fabricating different materials.

UNIT-I Conventional and Green fuels — 11Hrs.

Conventional Fuels: Introduction, classification, characteristics of good fuel, calorific value- (GCV& NCV), determination of calorific value using bomb calorimeter, numericals on GCV & NCV. Knocking in internal combustion engines–knocking mechanism, anti-knocking agents– anti knocking action of methyl tertiary butyl ether (MTBE) and ethyl tert-butyl ether (ETBE), importance of octane and cetane rating of fuel.

Green Fuels: Introduction, power alcohol– properties, applications and its limitations, biodiesel-synthesis by alkali catalyzed trans-esterification method, advantages and its applications. Production of green hydrogen by photocatalytic water splitting and its advantages, Hydrogen storage– Introduction, advantages and limitations of metal hydride and ammonia as chemical hydrogen carriers. Photovoltaic cells (PV cells)– construction, working, advantages, limitations and applications.

UNIT–II Energy systems and nanomaterials — 10Hrs.

Energy Systems: Batteries– Introduction, basic principle, classification of batteries, characteristics of battery: voltage, capacity, power density, shelf life and cycle life. Construction, working and applications of Li-ion battery and Na-ion battery. Fuel cells - Introduction, construction and working of methanol–oxygen fuel cell and solid oxide fuel cell (SOFCs) for auxiliary power units (APUs) applications, Construction, working and applications of vanadium redox flow battery, difference between fuel cell and battery.

Nanomaterials: Introduction, classification, size-dependent properties of nanomaterial-surface area, catalytical, electrical and thermal conductivity. Synthetic routes– Top down and bottom up approaches, synthesis of nano-materials by sol–gel and laser ablation methods, Nano scale materials– Nano clusters, Nano wires, carbon nano tubes and their applications.

UNIT–III Corrosion and Metal finishing — 11 Hrs.

Corrosion: Introduction, electrochemical theory of corrosion, types of electrochemical corrosion– differential metal corrosion, differential aeration corrosion(waterline and pitting) and stress corrosion in steam boilers, Factors affecting rate of corrosion, Corrosion control– metal coating; galvanization, surface conversion coating; anodization and cathodic protection; sacrificial anode method, corrosion

penetration rate (CPR) – Introduction and numericals on CPR (mmpy).

Metal finishing: Introduction, technological importance of metal finishing.
Electroplating process: Theory of electroplating– definition, principle components of an electroplating bath. Effects of plating variables on the nature of electro-deposit. Determination of throwing power of plating bath by Haring Blum Cell and numericals on throwing power. Electroplating of copper, chromium and applications.
Electroless plating: meaning, distinction between electroplating and electroless plating, surface preparation, Electroless plating of Cu on PCB and electroless plating of nickel on aluminium and applications.

UNIT–IV Polymer and Analytical techniques	**10 Hrs.**

Polymers: Introduction, polymerization, types of polymerization, Glass transition temperature (Tg), factor affecting Tg and its significance. Molar mass of polymers– number average and weight average molecular weight, numerical on $\overline{M_n}$ and $\overline{M_w}$, synthesis, properties and engineering applications of polyvinyl chloride (PVC), and poly methyl methacrylate (PMMA), Polymer composites– Introduction , fiber-reinforced polymers (FRPs); Kevlar–Synthesis, properties and industrial applications, 3D Printing materials– Introduction, synthesis, properties and applications of poly lactic acid (PLA) resin.

Analytical Technique: Sensors: Introduction, working principle, Potentiometric sensor; principle, instrumentation and its application in the estimation of iron in steel industry effluent. Conductometric sensor; Principle, instrumentation and its application in the estimation of acid mixture in electrochemical bath effluent. pH sensor; principle and its application in the estimation of pKa of acid electrolyte. Colorimetric sensor– principle, instrumentation and its application in the estimation of copper in brass.

Practical Module

1. Estimation of strength of acid in lead acid battery.
2. Determination of alkalinity of given boiler water sample.
3. Estimation of iron in TMT bar by diphenyl amine indicator method.
4. Estimation of total hardness of water by EDTA method.
5. Estimation of percentage of CaO in cement.
6. Estimation of acid mixture by conductometric sensor.
7. Estimation of iron in rust sample by Potentiometric sensor.
8. Determination of pKa of vinegar using pH sensor.
9. Colorimetric estimation of copper present in e-waste by optical sensor.
10. Determination of coefficient of viscosity of a lubricant by Ostwald's viscometer.
11. Data analysis of pka of a week acid and its interpretation using origin software.
12. Chemical structure drawing using software: Chem Draw/ Chem Sketch.

Text Books:

1. R. V. Gadag and Nityananda Shetty, A Text Book of Engineering Chemistry, I. K. International Publishing house. 2nd Edition, 2016.
2. Dr. Mahesh B and Dr. Roopashree B, , Engineering Chemistry, Publisher Sunstar Bengaluru, ISBN978-93-85155-70-3, 2022.
3. Dr. K. R. Mahadik & Dr. L. Sathiyanarayanan, Instrumental Methods of Analysis, Nirali, Prakashan, 2020.
4. V R Gowariker, N V Viswanathan, Jayadev, Sreedhar, Polymer Science, New Age Int. Publishers 4th Edition, 2021.
5. Douglas A. Skoog, F. James Holler, Stanley R., Principles of Instrumental Analysis, Cengage Learning Crouch Seventh Edition, 2020.

Reference Books:

1. Wiley Engineeering Chemistry, Wiley India Pvt.Ltd.,ISBN-978-81-265-47205, 5th Edition 2019.
2. Kirby W. Beard, Linden's Hand book of Batteries , Mc Graw Hill, FifthEdition,2019.
3. Takatoshi Tsujimura, OLED Display Fundamentals and Applications, Wiley–Blackwell, 2012.
4. F. H. Froes, etal. High Performance Metallic Materials for Cost Sensitive Applications John, Wiley & Sons, 2010.
5. PC Jain & MonicaJain, Engineering Chemistry, Dhanpat Rai Publication, 6th Edition. 2015.
6. Hari Singh,Nano structured materials and nanotechnology, Nalwa, academic press, 1st Edition, 2002.
7. Sulabha K Kulkarni, Nanotechnology Principles and Practices, Capital Publishing Company, 3rd Edition 2014.
8. Phanikumar, Principles of nano technology, Sci Tech publications, 2nd Edition,2010.
9. B.S. Jai Prakash, R. Venugopal, Sivakumaraiah & Pushpa Iyengar. Chemistry for Engineering Students, Subash Publications, 5th Edition, 2014.
10. O.G.Palanna, Engineering Chemistry, Tata Mc Graw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint, 2015.
11. Malini S KS Anantha Raju, Chemistry of Engineering materials, CBS publishers Pvt Ltd.
12. Anupma Rajput, Laboratory Manual Engg. Chemistry, Dhanpat Rai & Co.
13. Dr. S.S. Dhara and Dr. S.S. Umare, "A Text book of Engineering Chemistry" S.Chand & Co., Ltd., ISBN- 81-219-0359-9, 12th Edition 2011.

Web Links and Video Lectures

1. https://tasneemkhansite.wordpress.com/wp-content/uploads/2019/02/e-i-2-bomb-c.pdf
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SME1603.pdf
3. https://mcehassan.ac.in/assets/departments/CHE/materials/Energy,_Storage_and_Conversion.pdf
4. https://madar-ju.com/storage/images/files/file_1738779526YaGbl.pdf
5. https://www.rcet.org.in/uploads/academics/rohini_10009416162.pdf
6. https://www.informit.com/articles/article.aspx?p=2235827
   https://www.nrcmec.org/pdf/Content/NR25/FME/ppts/ece/i-semester/engineering-chemistry/unit-4/ppt.pdf
7. https://aiktc.ndl.gov.in/bitstreams/8b27e26c-cd04-41d4-b00a-902a70de44bf/download
8. https://www.youtube.com/watch?v=6Fk4DSMzlm8
9. https://youtu.be/tPCmj7dnb6w?list=PLzpBoXcNLUltsdSGokLPz3aiThovDWO3u
10. https://youtu.be/OGHsUevI14c
11. https://youtu.be/OGHsUevI14c?t=420
12. https://youtu.be/Yrz181Dnnlc
13. https://youtu.be/iZ6IZxCcP9Y
14. https://youtu.be/j_rNjiIiBKE
15. https://youtu.be/wVJ8WQax0rQ
16. https://youtu.be/hT7aLfwPVKs
17. https://youtu.be/20ATkRv-9To
18. https://youtu.be/WqUFevqldpI
19. https://youtu.be/1pED9NduPZ8
20. https://youtu.be/L4PsP92u_Po
21. https://youtu.be/NZrXDK5Plj4
22. https://youtu.be/3qd73a-qvMI
23. https://youtu.be/fVXR-6N6eeQ

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2									1		
	WK1	WK1											
	WK2	WK2											
	WK3	WK3											
CO2	3	2									1		
	WK1	WK1											
	WK3	WK3											
CO3	3	2									1		
	WK1	WK1											
	WK2	WK2											
	WK3	WK3											
CO4	3	2									1		
	WK1	WK1											
	WK3	WK3											
	WK1	WK1											
	WK3	WK3											

Note: All knowledge profile elements (WKs) mapped to a particular Program Outcome (PO) may not necessarily be addressed by all Course Outcomes (COs) of a course. For example, PO5 is addressed through CO2 and CO3 primarily using WK6, even though WK2 is also associated with PO5 at the program level. However, WK2 is not addressed by these COs in this course.