B.V.V.Sangha's

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE

DEPARTMENT OF CHEMISTRY

Course Title:	**Applied Chemistry for Electrical & Electronics Engineering stream**		
Course Code:	**BCHE102C/202C**	CIE Marks	50
Course Type(Theory/Practical)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours /Week (L:T:P:S)	3:0:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 to12 Lab slots	Credits	04

Course objectives

- To enable students to acquire knowledge on principles of chemistry for engineering applications.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To provide students with a solid foundation in analytical reasoning required to solve societal problems.

Teaching-Learning Process: These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching–Learning more effective

- Tutorial & remedial classes for needy students. (not regular T/R)
- Conducting Makeup classes/Bridge courses for needy students.
- Demonstration of concepts either by building models or by industry visit.
- Experiments in laboratories shall be executed in blended mode (conventional or non–conventional methods).
- Use of ICT– Online videos, online courses.
- Use of online platforms for assignments/Notes/ Quizzes (Ex. Google classroom).

MODULE1: Energy systems and Storage devices	**08 Hrs**

Electrode System: Introduction, Types of electrodes. Reference electrode - Introduction, calomel electrode–construction, working and applications of calomel electrode. Ion selective electrode– Principle, construction, working and applications of glass electrode. Determination of pH using glass electrode. Concentration cell – Definition, construction and numerical problems.

Batteries: Introduction, classification of batteries. Components, construction, working and applications of modern batteries; Na - ion battery and solid state battery (Li - polymer battery)

Fuel Cells: Introduction, construction, working and applications of methanol – oxygen and polymer electrolyte membrane (PEM) fuel cell.

Solar Energy: Introduction, importance of solar photo voltaic cell (PV), construction and working of solar PV cell, advantages and disadvantages.

Self-learning: Battery characteristics.

MODULE 2: Corrosion Science and E-waste Management	**08 Hrs**

Corrosion Chemistry: Introduction, electrochemical theory of corrosion (taking iron as an example), types of electrochemical corrosion- differential metal corrosion and differential aeration corrosion (waterline and pitting)

Corrosion control: Introduction, Metal coating -galvanization, surface conversion coating-anodization and cathodic protection - sacrificial anode method. Corrosion penetration rate (CPR) - numerical problems.

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

Self-learning: Stress corrosion and extraction of copper from e-waste.

MODULE 3: Chemistry of Materials	**08 Hrs**

Nanomaterials: Introduction, size dependent properties of nanomaterials (Catalytic and Conducting property), preparation of nanomaterials by sol-gel & chemical vapour deposition (CVD) method with example. Introduction, properties and applications – Nano fibers, Nano photonics and Nano sensors.

Polymers: Introduction, Molecular weight; Number average, Molecular weight, Weight average, Molecular weight and numerical problems. Synthesis, properties and application of silicone rubber and acrylonitrile butadiene styrene(ABS) plastic

Conducting polymers – Introduction, synthesis and conducting mechanism of polyacetylene (p & n-doping). Applications of conducting polymers.

Self-learning: Properties & electrochemical applications of carbon nanotubes and graphene.

MODULE 4: Liquid Crystals and Display Systems	**08 Hrs**

Liquid Crystals (LC's): Introduction, classification, positional and orientational order, director, requirements of a substance to exhibit liquid crystal state. Chemical constitution and liquid crystalline behavior, liquid crystal behavior in Para-azoxyanisole (PAA) homologous series. Electro optic effect in liquid crystals. Applications of Liquid Crystal in

Displays.

Light Emitting Diode (LED): Introduction, construction, working principle and applications of LED.

Organic Light Emitting Diode (OLED): Introduction, anatomy of OLED, types of OLED. Comparison between LED and OLED. Advantages and disadvantages of OLED, applications of OLED. Quantum light emitting diodes (QLED's); Properties and applications. Light emitting electrochemical cells.

Self Learning: Properties and functions of Silicon (Si), Germanium (Ge), Copper (Cu), Aluminium (Al) and Brominated flame retardants in computers.

MODULE 5 : Sensors and Analytical Techniques	**08 Hrs**

Sensors-Introduction, basic principle of sensor, Types of sensors; Electrochemical sensors (gas sensors, bio sensors, conductometric sensors, potentiometric,), optical sensors, thermometric sensors.

Analytical Techniques: Potentiometric sensors; Introduction, principle, working and application in the estimation of iron. Colorimetric sensors; Introduction, principle, working and application in the estimation of copper. Conductometric sensors; Introduction, principle, working and application in the estimation of weak acid. pH sensors; Introduction, principle, working and application in the determination of pH of soil sample.

Self-learning: Electro chemical gas sensor for SOx and NOx

PRACTICAL MODULE

A– Demonstration (any one) offline / virtual:

A1. Electrogravimetric estimation of metals
A2. Determination of strength of an acid in Pb-acid battery
A3. Synthesis of Iron – oxide Nanoparticles
A4. Determination of chloride in water by Mohr's method.

B – Exercise (compulsorily any 4 to be conducted):

B1. Conductometric estimation of acid mixture.
B2. Potentiometric estimation of FAS using $K_2Cr_2O_7$.
B3. Determination of pKa of vinegar using pH sensor (Glass electrode).
B4. Estimation of total hardness of water by EDTA method.
B5. Determination of rate of corrosion of mild steel by weight loss method.

C – Structured Enquiry (compulsorily any 4 to be conducted):

C1. Estimation of Copper present in electroplating effluent by optical sensor(colorimetry).
C2. Determination of viscosity coefficient of lubricant (Ostwald's viscometer).
C3. Estimation of iron in TMT bar by diphenyl amine/external indicator method.
C4. Determination of alkalinity of water sample by dual indicator method.
C5. Determination of chemical oxygen demand(COD) of industrial waste water sample.

D – Open Ended Experiments (any one):

D1. Determination of percentage of copper in brass solution.
D2. Determination of percentage of CaO in cement solution.
D3. Evaluation of acid content in beverages by using pH sensors.
D4.Design an experiment to identify the presence of proteins in given sample.

Course outcome(Course Skill Set) At the end of the course the student will be able to:	
CO1.	Identify the terms process involved in scientific and engineering applications.
CO2.	Explain the phenomena of chemistry to describe the methods of engineering processes.
CO3.	Solve the problems in chemistry that are pertinent in engineering applications
CO4.	Apply the basic concepts of chemistry to explain the chemical properties and processes.
CO5.	Analyze properties and multi disciplinary processes associated with chemical substances in situations.

B.V.V.Sangha's

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE

DEPARTMENT OF CHEMISTRY

Course Title:	**Applied Chemistry for Mechanical Engineering stream**		
Course Code:	**BCHM102C/202C**	CIE Marks	50
Course Type (Theory/Practical)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours /Week (L:T:P:S)	3:0:2:0	Exam Hours	03
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- Experiments in laboratories shall be executed in blended mode (conventional or non–conventional methods)
- Use of ICT– Online videos, online courses
- Use of online platforms for assignments/Notes/ Quizzes (Ex. Google classroom)

MODULE 1: Energy; Source, Conversion and Storage	**08 Hrs**

Fuels: Introduction, definition, classification of fuels, calorific value determination of calorific value using bomb calorimeter. Numerical problems on gross calorific value (GCV) and net calorific value (NCV).

Green fuels: Introduction to different types of green fuels, power alcohol, synthesis and applications of biodiesel(mechanism of base catalysed transesterification)

High energy fuels: Production of hydrogen by electrolysis of water and its advantages.

Energy devices: Introduction, construction, working and applications of photovoltaic cells, Li-ion battery, Fuel cell – Introduction, methanol-oxygen fuel cell.

Self-learning: Plastic recycling to fuels and its monomers or other useful products.

MODULE 2: Corrosion Science and Metal Finishing	**08 Hrs**

Corrosion: Introduction, electrochemical theory of corrosion, types of corrosion- differential metal, differential aeration (waterline and pitting), stress corrosion (caustic embrittlement).

Corrosion control: Introduction, Metal coating -galvanization, surface conversion coating-anodization and cathodic protection- sacrificial anode method. Corrosion penetration rate (CPR) - numerical problems.

Metal finishing: Introduction, technological importance. Electroplating: Process. Electroplating of chromium (hard and decorative). Throwing power – determination and numerical problems. Electrolessplating: Introduction, electroless plating of nickel.

Self-learning: Factors affecting the rate of corrosion, factors influencing the nature and quality of electro deposit (current density, concentration of metal ion, pH and temperature)**.**

MODULE 3: Macromolecules for Engineering Applications	**08 Hrs**

Polymers: Introduction, types of polymerization, molecular weight; number average and weight average, numerical problems. Synthesis, properties and industrial applications of silicone rubber, ABS plastics.

Fibers: Introduction, synthesis, properties and industrial applications of kevlar and polyester.

Plastics: Introduction, synthesis, properties and industrial applications of poly methyl methacrylate (PMMA) and Teflon.

Composites: Introduction, properties and industrial applications of carbon - based reinforced composites (graphene/carbon nanotubes as fillers) and metal matrix polymer composites.

Lubricants: Introduction, classification, properties and applications of lubricants.

Self-learning: Biodegradable polymer: Introduction, synthesis, properties & applications of poly lactic acid (PLA).

MODULE 4: Phase Rule and Analytical Techniques	**08 Hrs**

Phase rule: Introduction, definition of terms: phase, components, degree of freedom, phase rule equation. Phase diagram: one component water system, two component lead-silver system

Analytical techniques: Introduction, principle, instrumentation of potentiometric

sensors; its application in the estimation of iron, Optical sensors (colorimetry); its application in the estimation of the copper, pH- sensor(Glass electrode);its application in the determination of pH of beverages.

Self-learning: One component sulphur system.

MODULE 5 : Materials for Engineering Applications	**08 Hrs**

Alloys: Introduction, classification, composition, properties and applications of stainless steel, brass and alnico.

Refractories: Introduction, classification based on chemical composition, properties, and applications of refractory materials.

Abrasives: Introduction, classification, properties and applications of silicon carbide (carborundum).

Nano chemistry: Introduction, size - dependent properties of nanomaterial (catalytical and thermal), synthesis of nanoparticles by sol-gel, and chemical vapour deposition (CVD).

Nanomaterials: Introduction, properties and engineering applications of carbon nano tubes and graphene.

Self-learning: Classification of nanomaterials

PRACTICAL MODULE

A– Demonstration (any one) offline / virtual:

A1. Electrogravimetric estimation of metals
A2. Determination of strength of an acid in Pb-acid battery
A3. Synthesis of Iron – oxide Nanoparticles
A4. Determination of chloride in water by Mohr's method.

B – Exercise (compulsorily any 4 to be conducted):

B1. Conductometric estimation of acid mixture
B2. Potentiometric estimation of FAS using $K_2Cr_2O_7$
B3. Determination of pKa of vinegar using pH sensor (Glass electrode)
B4. Estimation of total hardness of water by EDTA method
B5. Determination of rate of corrosion of mild steel by weight loss method

C – Structured Enquiry (compulsorily any 4 to be conducted):

C1. Estimation of copper present in electroplating effluent by optical sensor(colorimetry).
C2. Determination of viscosity coefficient of lubricant (Ostwald's viscometer).
C3. Estimation of iron in TMT bar by diphenyl amine/external indicator method.
C4. Determination of alkalinity of water sample by dual indicator method.

C5. Determination of chemical oxygen demand (COD) of industrial waste water sample.

D – Open Ended Experiments (any one):

D1. Determination of percentage of copper in brass solution.
D2. Determination of percentage of CaO in cement solution.
D3. Evaluation of acid content in beverages by using pH sensors.
D4. Design an experiment to Identify the presence of proteins in given sample.

Course outcome(Course Skill Set) At the end of the course the student will be able to:	
CO1.	Identify the terms process involved in scientific and engineering applications
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CO4.	Apply the basic concepts of chemistry to explain the chemical properties and processes
CO5.	Analyze properties and multi disciplinary processes associated with chemical substances in situations

B.V.V.Sangha's

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE

DEPARTMENT OF CHEMISTRY

Course Title:	**Applied Chemistry for Civil Engineering stream**		
Course Code:	**BCHC102C/202C**	CIE Marks	50
Course Type(Theory/Practical)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week(L:T:P:S)	3:0:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 to12 Lab slots	Credits	04

Course objectives

- To enable students to acquire knowledge on principles of chemistry for engineering applications.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
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Teaching-Learning Process: These are sample strategies, which teacher can use to accelerate the attainment of the various course out comes and make Teaching–Learning more effective

- Tutorial & remedial classes for needy students (not regular T/R)
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- Experiments in laboratories shall be executed in blended mode (conventional or non–conventional methods)
- Use of ICT– Online videos, online courses
- Use of online platforms for assignments/Notes/ Quizzes (Ex. Google classroom)

MODULE 1: Structural Materials	**08 Hrs**

Metals and Alloys: Introduction, properties and application of iron and its alloys (wrought iron and steel), aluminium and its alloys (Duralumin & magnalium).

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

Refractories: Introduction, classification based on chemical composition, properties and applications of refractory materials.

Glass: Introduction, composition and types. Preparation of Soda-lime glass, properties and applications of glass.

Self-learning: Chemistry of reinforced concrete from various sources of water (sea water, ground water, treated water).

MODULE 2: Energy Systems and Storage, Corrosion	08 Hrs

Energy systems: Introduction, types of electrodes. Reference electrodes: Calomel electrode - construction, working and applications. Fuel cell: Introduction, construction, working and applications of Methanol -oxygen fuel cell.

Storage devices: Introduction, construction and working of Li-ion battery and Na-ion battery.

Corrosion: Introduction, electrochemical corrosion of steel in concrete, types (differential metal corrosion and differential aeration corrosion). Stress corrosion in civil structures.

Corrosion control: Introduction, Design and selection of materials, Metal coating - galvanization, surface conversion coating - anodization and cathodic protection - sacrificial anode method. Corrosion penetration rate (CPR) - numerical problems.

Self Learning: Corrosion inhibitors.

MODULE 3: Water Technology and Nanotechnology	08 Hrs

Water technology: Introduction, water parameters, hardness of water, determination of temporary, permanent and total hardness of water by EDTA method, numerical problems. Softening of water by ion exchange method. Desalination of water by electro-dialysis. Forward osmosis: Introduction, process and its applications. Determination of chemical oxygen demand (COD) and numerical problems.

Nanotechnology: Introduction, size dependent properties of nanomaterial (catalytic and mechanical), Synthesis of nanomaterial by sol-gel method and chemical vapour deposition (CVD) method. Nanomaterials: Introduction, properties and engineering applications of carbon nanotubes, graphene and nanomaterials for water treatment (Metal oxide).

Self-learning: Determination of DO by Winkler's method.

MODULE 4: Polymer and Composites	08 Hrs

Polymer: Introduction, types of polymerization, molecular weight of polymers; number average and weight average molecular weight of polymers, numerical problems. Synthesis, properties and engineering applications of silicone rubber and acrylonitrile butadiene styrene (ABS) plastics. Fibers- Synthesis, properties and applications of nylon fibers.

Polymer composites: Introduction, properties & applications of fiber reinforced polymers composites (FRPC).

Geopolymer concrete: Introduction, synthesis, constituents, properties and applications.

Adhesives: Introduction, synthesis, properties and applications of epoxy resin.

Biodegradable polymers: Introduction, synthesis of poly lactic acid (PLA) and their applications.

Self-learning: Biopolymer: Introduction, applications of cellulose and lignin.

MODULE 5 : Sensors and Analytical Techniques	**08 Hrs**

Sensors-Introduction, basic principle of sensor, Types of sensors; Electrochemical sensors (gas sensors, bio sensors, conductometric sensors, potentiometric sensors), optical sensors, thermometric sensors.

Analytical Techniques: Potentiometric sensors; Introduction, principle, working and application in the estimation of iron. Colorimetric sensors; Introduction, principle, working and application in the estimation of copper. Conductometric sensors; Introduction, principle, working and application in the estimation of weak acid. pH sensors; Introduction, principle, working and application in the determination of pH of soil sample.

Self-learning: Electro chemical gas sensor for SOx and NOx

PRACTICAL MODULE

A– Demonstration (any one) offline / virtual:

A1. Electrogravimetric estimation of metals.
A2. Determination of strength of an acid in Pb-acid battery.
A3. Synthesis of Iron – oxide Nanoparticles.
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B – Exercise (compulsorily any 4 to be conducted):

B1. Conductometric estimation of acid mixture.
B2. Potentiometric estimation of FAS using $K_2Cr_2O_7$.
B3. Determination of pKa of vinegar using pH sensor (Glass electrode).
B4. Estimation of total hardness of water by EDTA method.
B5. Determination of rate of corrosion of mild steel by weight loss method.

C – Structured Enquiry (compulsorily any 4 to be conducted):

C1. Estimation of copper present in electroplating effluent by optical sensor(colorimetry).
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B.V.V.Sangha's

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE

DEPARTMENT OF CHEMISTRY

Course Title:	**Applied Chemistry for Computer Science & Engineering stream**		
Course Code:	**BCHS102C/202C**	CIE Marks	50
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MODULE 1: Energy Systems	**08 Hrs**

Electrode System: Introduction, types of electrodes. Reference electrode-Introduction. Calomel electrode - construction, working and applications of calomel electrode. Ion selective electrode- Principle, construction, working and applications of glass electrode. Determination of pH using glass electrode. Concentration cell- Definition, Construction, working and Numerical problems.

Storage Systems: Introduction to batteries, Definition, Components and Classification. Construction, working and applications of Lithium-ion battery and Sodium ion battery.

Renewable Fuels: Introduction to different types of renewable fuels (solar, wind, tidal and biofuel). PV cell; Introduction, construction, working and applications of PV cell. Quantum Dot sensitized solar cells (QDSSC's)- Principle, properties and applications.

Self Learning: Fuel Cell- Methanol- Oxygen fuel cell.

MODULE 2: Corrosion and Polymers	**08 Hrs**

Corrosion Chemistry: Introduction, electro chemical theory of corrosion taking iron as an example. Types of electrochemical corrosion- Differential metal - Differential aeration– (Waterline and pitting).

Corrosion control: Introduction, Metal coating -galvanization, Surface conversion coating- anodization, Cathodic protection - sacrificial anode method. Corrosion testing by weight loss method. Corrosion penetration rate (CPR) - numerical problems.

Polymers: Introduction. Molecular weight of polymers- Number average (Mn) & weight average (Mw) molecular weight and numerical problems.

Polymer Composites: Introduction, Basic concepts, preparation, properties and applications of carbon fiber and Kevlar.

Conducting polymers – Introduction, synthesis of poly acetylene, conducting mechanism of polyacetylene (n and p type doping) and commercial applications.

Self Learning: Biopolymer: Introduction, structural properties and applications of cellulose and lignin.

MODULE 3: Liquid Crystals and Display systems	**08 Hrs**

Liquid Crystals (LC's): Introduction, classification, positional and orientational order, director, requirements of a substance to exhibit liquid crystal state. Chemical constitution and liquid crystalline behavior, liquid crystal behavior in Para azoxy anisole (PAA) homologous series. Electro optic effect in liquid crystals. Applications of liquid crystal in displays.

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Organic Light Emitting Diode (OLED): Introduction, anatomy of OLED, types of OLED. Comparison between LED and OLED. Advantages and Disadvantages of OLED, applications of OLED. Quantum Light Emitting Diodes (QLED's); Properties and applications. Light emitting electrochemical cells.

Self Learning: Properties and functions of Silicon (Si), Germanium(Ge), Copper(Cu), Aluminium(Al) and Brominated flame retardants in computers.

MODULE 4: Sensors and Analytical Technique	**08 Hrs**

Sensors-Introduction, basic principle of sensor, Types of sensors; Electrochemical sensors (gas sensors, bio sensors, conductometric sensors, potentiometric), optical sensors, thermometric sensors.

Analytical Techniques: Potentiometric sensors; Introduction, principle, working and application in the estimation of iron. Colorimetric sensors; Introduction, principle, working and application in the estimation of copper. Conductometric sensors; Introduction, principle, working and application in the estimation of weak acid. pH sensors; Introduction, principle, working and application in the determination of pH of soil sample.

Self-learning: Electro chemical gas sensor for SOx and NOx

MODULE 5 : E- Waste Management	**08 Hrs**

E-Waste: Introduction, sources of e-waste, composition, characteristics and need of e-waste management. Toxic materials used in manufacturing electronic and electrical products, health hazards due to exposure to e-waste. Recycling and recovery: Different approaches of recycling (separation, thermal treatment, hydrometallurgical extraction, pyrometallurgical methods, direct recycling). Extraction of gold from e-waste. Role of stakeholders in environmental management of e-waste (producers, consumers, recyclers and statutory bodies).

Self Learning: Extraction of copper from e-waste

PRACTICAL MODULE

A– Demonstration (any one) offline / virtual:

A1. Electrogravimetric estimation of metals
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