Civil Engineering and Allied branches(Chemistry group)

Course Title:	Applied Chemistry for Civil Engineering stream		
Course Code:	BCHEC202 /202	CIE Marks	50
Course Type(Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
TeachingHours/Week(L:T:P:S)[1]	2:2:2:0	Exam Hours	03
TotalHoursofPedagogy	40hoursTheory+10to12Labslots	Credits	04

Course objectives

- Toenablestudentstoacquireknowledgeonprinciplesofchemistryforengineeringapplications.
- Todevelopanintuitiveunderstandingofchemistrybyemphasizingtherelatedbranchesofengineering.
- Toprovidestudentswithasolidfoundationinanalyticalreasoningrequiredtosolvesocietal problems.

Teaching-LearningProcess

Thesearesamplestrategies,whichteachercanusetoacceleratetheattainmentofthevariouscourseoutcomesandmakeTeaching–Learningmoreeffective

- Tutorial&remedialclassesforneedystudents(notregularT/R)
- ConductingMakeupclasses/Bridgecoursesforneedystudents
- Demonstrationofconceptseitherbybuildingmodelsorbyindustryvisit
- Experimentsinlaboratoriesshallbeexecutedinblendedmode(conventionalornon–conventionalmethods)
- UseofICT–Onlinevideos,onlinecourses
- Useofonlineplatformsforassignments/Notes/Quizzes(Ex.Googleclassroom)

Module-1:StructuralMaterials(8hr)

MetalsandAlloys: Introduction,PropertiesandapplicationofIronanditsalloys,Aluminiumanditsalloys

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

Refractories: Introduction, classification based on chemical composition, properties andapplicationofrefractorymaterials.

Glass: Introduction, Composition, Types, Preparation of Soda-lime glass, properties andapplicationsofglass.

Self-learning: Chemistryofreinforcedconcretefromvarioussourcesofwater(seawater, groundwater,treatedwater).

Module-2:EnergyConversionandStorage,Corrosion(8hr)

Energyconversion: Introduction,construction,working,andapplicationsofPhotovoltaiccells, methanol-oxygenfuelcell.

Storagedevices: Introduction,constructionandworkingofLi-ionbattery.

1.NOTE:Whereverthecontact hoursisnotsufficient,tutorialhourcanbeconvertedto theoryhours

Corrosion: Introduction, electrochemical corrosion of steel in concrete, types (differentialmetalandaeration),Stresscorrosionincivilstructures,corrosioncontrol(designandselectionofmaterials,galvanization, anodizationandsacrificialanodemethod).
Self-learning: Corrosioninhibitors

Module-3:WaterTechnologyandNanotechnology(8hr)

Water technology: Introduction, water parameters, hardness of water, determination oftemporary, permanent and total hardness by EDTA method, numerical problems, softeningof water by ion exchange method, desalination of water by electrodialysis, determination ofCOD,numericalproblems.Forwardosmosis: Introduction, Processandapplications.
Nanotechnology: Introduction, size dependent properties of nanomaterial (surface areaandcatalytic),Synthesisofnanomaterialbysol-gelmethodandco-precipitationmethod.
Nanomaterials: Introduction,propertiesandengineeringapplicationsofcarbonnanotubes, grapheneandnanomaterialsforwatertreatment(Metaloxide).
Self-learning: Sewagetreatment(Primary,secondaryandtertiary)

Module-4:PolymerandComposites(8hr)

Polymer: Introduction,methodsofpolymerization,molecularweightofpolymers,numerical problems. Synthesis, properties and engineering applications of polyethylene(PE)and Chloropolyvinylchloride(CPVC).
Fibers:Synthesis,propertiesandapplicationsofnylonfibers.
Polymercomposites:Introduction,propertiesandapplicationsoffiberreinforcedpolymerscomposites(FRPC),
Geopolymerconcrete:Introduction,synthesis,constituents,propertiesandapplications.
Adhesives:Introduction,propertiesandapplicationsofepoxyresin.
Biodegradablepolymers:Synthesisofpolylacticacid(PLA)andtheirapplications.
Self-learning:Biopolymer:Introduction,structuralproperties,andapplicationsofcelluloseandlignin.

Module-5:PhaseRuleandAnalyticalTechniques(8hr)

Phase rule: Introduction, Definition of terms: phase, components, degree of freedom, phaseruleequation.Phase diagram:Twocomponent-lead-silversystem.
Analytical techniques: Introduction, principle, instrumentation of potentiometric sensorsand its application in the estimation of iron, conductometric sensors and its application inthe estimation of acid mixture, pH-sensorsanditsapplicationinthedeterminationofsoilsample.
Self-learning: Chromatographictechnique,applicationofchromatography(columnand thin-layeredchromatography)intheseparationofcomponents.

PRACTICALMODULE

A–Demonstration(anytwo)offline/virtual:

A1.Synthesisofpolyurethane
A2. Quantitative estimation of Aluminium by precipitation methodA3.Synthesisofironoxidenanoparticles
A4.DeterminationofchloridecontentinthegivenwatersamplebyArgentometricmethod

B–Exercise(compulsorilyany4tobe conducted):

B1.Conductometricestimationofacidmixture
B2.PotentiometricestimationofFASusing$K_2Cr_2O_7$

B3.DeterminationofpKaofvinegarusingpHsensor(Glasselectrode)
B4.Determinationofrateofcorrosionofmildsteelbyweightlossmethod B5.Estimation oftotalhardnessofwaterbyEDTAmethod

C–StructuredEnquiry (compulsorilyany4tobeconducted):

C1. Estimation of Copper present in electroplating effluent by optical sensor (colorimetry) C2.DeterminationofViscositycoefficientoflubricant(Ostwald'sviscometer)
C3. Estimation of iron in TMT bar by diphenyl amine/external indicator methodC4.EstimationofSodiumpresentinsoil/effluentsampleusingflamephotometr y
C5.DeterminationofChemicalOxygenDemand(COD)ofindustrialwastewatersample

D–OpenEndedExperiments(anytwo):

D1. Gravimetric estimation of gypsum in Portland cementD2.Electroplatingofdesiredmetalonsubstrate
D3.Estimationofmanganesedioxideinpyrolusite
D4.Analysisofcementforits components

Courseoutcome(CourseSkillSet)

Attheendofthecourse thestudentwillbeableto:

CO1.	Identify the terms processes involved in scientific and engineering andapplications
CO2.	Explainthephenomenaofchemistrytodescribethemethodsofengineeringprocesses
CO3.	Solvefortheproblemsinchemistrythatarepertinentinengineeringapplications
CO4.	Applythebasicconceptsofchemistrytoexplainthechemicalpropertiesandprocesses
CO5.	Analyze processes associated withchemical substances in propertiesandmu ltidisciplinarysituations

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50).The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). Astudentshallbedeemedtohavesatisfiedtheacademicrequirementsandearnedthecreditsallotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in thesemester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total oftheCIE(ContinuousInternalEvaluation)andSEE(SemesterEndExamination)takentogether.

ContinuousInternalEvaluation(CIE):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks**.

CIE for the theory component of the IC

- Three Tests each of 20 Marks**;** after the completion of the syllabus of 35-40%, 65-70%, and 90-100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester/after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

SuggestedLearningResources:

Books(TitleoftheBook/Nameoftheauthor/Nameofthepublisher/EditionandYear)

1. WileyEngineeringChemistry,WileyIndiaPvt.Ltd.NewDelhi,2013-2nd Edition.
2. EngineeringChemistry,Satyaprakash&ManishaAgrawal,KhannaBookPublishing,Delhi
3. ATextBookofEngg.Chemistry,ShashiChawla,DhanpatRai&Co.(P)Ltd.
4. EssentialsofPhysicalChemistry,Bahl&Tuli,S.ChandPublishing
5. AppliedChemistry,SunitaRattan,Kataria5.EngineeringChemistry,Baskar,Wiley
6. EngineeringChemistry–I,D.GrourKrishana,VikasPublishing
7. ATextbookofEngineeringChemistry,SSDara&Dr.SSUmare,SChand&CompanyLtd.,12th Edition,2011.
8. ATextBookofEngineeringChemistry,R.V.GadagandNityanandaShetty,I.K.International Publishinghouse.2nd Edition,2016.
9. TextBookofPolymerScience,F.W.Billmeyer,JohnWiley&Sons,4th Edition,1999.
10. NanotechnologyAChemicalApproachtoNanomaterials,G.A.Ozin&A.C.Arsenault,RSCPublishing,2005.
11. CorrosionEngineering,M.G.Fontana,N.D.Greene,McGrawHillPublications,NewYork,3rd Edition, 1996.
12. Linden'sHandbookofBatteries,KirbyW.Beard,FifthEdition,McGrawHill,2019.
13. OLEDDisplayFundamentalsandApplications,Takatoshi Tsujimura,Wiley–Blackwell,2012
14. Supercapacitors: Materials, Systems,andApplications, MaxLu, Francois Beguin,Elzbieta Frackowiak,Wiley-VCH;1st edition,2013.
15. "HandbookonElectroplatingwithManufactureofElectrochemicals",ASIAPACIFICBUSINESSPRESS Inc.,2017.Dr. H.Panda.
16. ExpandingtheVisionofSensorMaterials.NationalResearchCouncil1995,Washington,DC:TheNationalAcademies Press. doi:10.17226/4782.
17. EngineeringChemistry,EditedbyDr.MaheshBandDr.RoopashreeB,SunstarPublisher,Bengaluru,

ISBN978-93-85155-70-3, 2022.
18. HighPerformanceMetallicMaterialsforCostSensitiveApplications,F.H.Froes,etal.JohnWiley&Sons, 2010.
19. InstrumentalMethodsofAnalysis,Dr. K.R.Mahadik andDr.L.Sathiyanarayanan,NiraliPrakashan,2020.
20. PrinciplesofInstrumentalAnalysis,DouglasA.Skoog,F.JamesHoller,StanleyR.CrouchSeventhEdition,CengageLearning, 2020.
21. PolymerScience,VRGowariker,NVViswanathan,Jayadev,Sreedhar,NewageInt.Publishers,4thEdition, 2021
22. EngineeringChemistry,PCJain&MonicaJain,DhanpatRaiPublication,2015-16thEdition.
23. Nanostructuredmaterialsandnanotechnology,Hari Singh, Nalwa,academicpress, 1stEdition,2002.
24. NanotechnologyPrinciplesandPractices,SulabhaKKulkarni,CapitalPublishingCompany,3rdEdition2014
25. Principlesofnanotechnology,Phanikumar,Scitechpublications,2ndEdition,2010.
26. Chemistryfor EngineeringStudents,B.S.JaiPrakash,R.Venugopal, Sivakumaraiah&PushpaIyengar.,SubashPublications,5thEdition, 2014
27. "EngineeringChemistry",O.G.Palanna,TataMcGrawHillEducationPvt.Ltd.NewDelhi,FourthReprint,2015.
28. ChemistryofEngineeringmaterials,MaliniS,KSAnanthaRaju,CBSpublishersPvtLtd.,
29. LaboratoryManualEngg.Chemistry,AnupmaRajput,DhanpatRai&Co.

WeblinksandVideoLectures(e-Resources):

- http://libgen.rs/
- https://nptel.ac.in/downloads/122101001/
- https://nptel.ac.in/courses/104/103/104103019/
- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X-9IbHrDMjHWWh
- https://www.youtube.com/watch?v=j5Hml6KN4TI
- https://www.youtube.com/watch?v=X9GHBdyYcyo
- https://www.youtube.com/watch?v=1xWBPZnEJk8
- https://www.youtube.com/watch?v=wRAo-M8xBHM

ActivityBasedLearning(SuggestedActivitiesinClass)/PracticalBasedlearning

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

COsandPOsMapping(Individualteacherhastofillup)

	PO											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**1**				**1**					
CO2	**3**	**1**	**1**				**1**					
CO3	**3**	**1**	**1**				**1**					
CO4	**3**	**1**	**1**				**1**					
CO5	**3**	**1**	**1**				**1**					

16-2-2023