

Electrical & Electronics Engineering and Allied branches(Chemistry group)

CourseTitle:	Chemistry for Electrical and Electronics Engineering stream		
CourseCode:	BCHEE202/202	CIEMarks	50
Course Type(Theory/Practical/Integrated)	Integrated	SEEMarks	50
		Total Marks	100
TeachingHours/Week(L:T:P:S) ¹	2:2:2:0	Exam Hours	03
TotalHoursofPedagogy	40hoursTheory+10to 12Lab slots	Credits	04
Courseobjectives - 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)			
MODULE1:ChemistryofElectronicMaterials(8hr)			
ConductorsandInsulators: Introduction,principlewithexamples. Semiconductors: Introduction, production of electronic grade silicon-Czochralski process(CZ) andFloatZone(FZ)methods. Polymers: Introduction,Molecularweight-Numberaverage,Weightaverageandnumericalproblems.Conductingpolymers-synthesisandconductingmechanismofpolyacetylene.Preparation, propertiesandcommercialapplicationsofgrapheneoxide. PCB: Electroless plating – Introduction, Electroless plating of copper in the manufacture ofdouble-sidedPCB. Self-learning: Technologicalimportanceofmetalfinishinganddistinctionbetween electroplatingandelectrolessplating.			
MODULE2:EnergyConversionandStorage(8hr)			
Batteries: Introduction, classification of batteries. Components, construction, working andapplications of modern batteries; Na-ion battery, solid state battery (Li-polymer battery)andflowbattery(Vanadiumredoxflowbattery). FuelCells: Introduction,construction,workingandapplicationsofmethanol-oxygenand			

1.NOTE: Whereverthecontact hoursisnotsufficient,tutorialhourcanbeconvertedto theoryhours

polymerelectrolytemembrane(PEM)fuelcell.

SolarEnergy:Introduction,importanceofsolarPVcell,constructionandworkingofsolarPVcell,advantagesanddisadvantages.

Self-learning:Electrodesforelectrostaticdoublelayercapacitors,pseudocapacitors,and hybridcapacitor.

MODULE3:CorrosionScienceandE-wasteManagement(8hr)

CorrosionChemistry:Introduction,electrochemicaltheoryofcorrosion,typesofcorrosion-differentialmetalanddifferentialaeration.Corrosioncontrol-galvanization,anodization and sacrificial anode method. Corrosion Penetration Rate (CPR) - Introductionandnumerical problem.

E-waste Management: Introduction, sources, types, effects of e-waste on environment andhuman health, methods of disposal, advantages of recycling. Extraction of copper and goldfrome-waste.

Self-learning:RecyclingofPCBandbatterycomponents

MODULE4:NanomaterialsandDisplaySystems(8hr)

Nanomaterials: Introduction, size dependent properties of nanomaterials (Surface area,Catalytic, Conducting), preparation of nanomaterials by sol-gel and co-precipitation methodwithexample.Introduction,propertiesandapplications- Nanofibers,Nanophotonics,Nanosensors.

DisplaySystems:Liquidcrystals(LC's)-Introduction,classification,propertiesandapplication in Liquid Crystal Displays (LCD's). Properties and application of Organic LightEmittingDiodes(OLED's)andQuantumLightemittingdiodes(QLED's).

PerovskiteMaterials:Introduction,propertiesandapplicationsinoptoelectronicdevices.

Self-learning:Properties&electrochemicalapplicationsofcarbonnanotubesandgraphene.

MODULE5:SensorsinAnalyticalTechniques(8hr)

Electrode System: Introduction, types of electrodes. Ion selective electrode – definition,construction, working and applications of glass electrode. Determination of pH using glasselectrode. Reference electrode- Introduction, calomel electrode– construction, workingand applicationsof calomelectrode.Concentrationcell– Definition,constructionandNumericalproblems.

Sensors:Introduction,workingprincipleandapplicationsofConductometricsensors,Electrochemicalsensors, Thermometricsensors, andOpticalsensors.

AnalyticalTechniques:Introduction,principleandinstrumentationofColorimetricsensors; its application in the estimation of copper, principleandinstrumentationof Potentiometric sensors; principleandinstrumentationof its applicationin the estimation of iron, Conductometric sensors; its application in the estimation of weakacid.

Self-learning:IRandUV-Visiblespectroscopy.

PRACTICALMODULE

A-Demonstration(anytwo)offline/virtual:

A1.Synthesisofpolyurethane

A2. Determination of strength of an acid in Pb-acid

batteryA3.Synthesisofironoxidenanoparticles

A4.Electroplatingofcopperonmetallicobjects

B-Exercise(compulsorilyany4tobeconducted):

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

C-Structured Enquiry (compulsorilyany4tobeconducted):

- 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. Estimation of Sodium present in soil/effluent sample using flame photometry
 C5. Determination of Chemical Oxygen Demand (COD) of industrial wastewater sample

D-Open Ended Experiments (any two):

- D1. Estimation of metal in e-waste by optical sensors
 D2. Electroless plating of Nickel on Copper
 D3. Determination of glucose by electrochemical sensors
 D4. Synthesis of polyaniline and its conductivity measurement

Course outcome (Course Skill Set)

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

CO1.	Identify the terms and processes 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 processes associated with chemical substances in disciplinary situations

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. 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). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (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.

Suggested Learning Resources:

Books(TitleoftheBook/Nameoftheauthor/Nameofthepublisher/EditionandYear)

1. WileyEngineeringChemistry,WileyIndiaPvt.Ltd.NewDelhi,2013-2ndEdition.
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.Grouar Krishana,VikasPublishing
7. ATextbookofEngineeringChemistry,SSDara&Dr.SSUmare,SChand&CompanyLtd.,12thEdition,2011
8. ATextBookofEngineeringChemistry,R.V.GadagandNityanandaShetty,I.K.InternationalPublishinghouse. 2ndEdition,2016.
9. TextBookofPolymerScience,F.W.Billmeyer,JohnWiley&Sons,4thEdition,1999.
10. NanotechnologyAChemicalApproachtoNanomaterials,G.A.Ozin &A.C.Arsenault,RSCPublishing,2005.
11. CorrosionEngineering,M.G.Fontana,N.D.Greene,McGrawHillPublications,NewYork,3rdEdition,1996.
12. Linden'sHandbookofBatteries,KirbyW.Beard,FifthEdition,McGrawHill,2019.
13. OLEDDisplayFundamentalsandApplications,TakatoshiTsujiMura,Wiley-Blackwell,2012
14. Supercapacitors: Materials, Systems, and Applications, Max Lu, Francois Beguin,ElzbietaFrackowiak,Wiley-VCH;1st edition,2013.

15. "Handbook on Electroplating with Manufacture of Electrochemicals", ASIAPACIFIC BUSINESS PRESS Inc., 2017. Dr. H. Panda,
16. Expanding the Vision of Sensor Materials. National Research Council 1995, Washington, DC: The National Academies Press. doi:10.17226/4782.
17. Engineering Chemistry, Edited by Dr. Mahesh Band and Dr. Roopashree B, Sunstar Publisher, Bengaluru, ISBN 978-93-85155-70-3, 2022
18. High Performance Metallic Materials for Cost Sensitive Applications, F.H. Froes, et al. John Wiley & Sons, 2010
19. Instrumental Methods of Analysis, Dr. K. R. Mahadik and Dr. L. Sathiyarayanan, Nirali Prakashan, 2020
20. Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler, Stanley R. Crouch Seventh Edition, Cengage Learning, 2020
21. Polymer Science, V. R. Gowarikar, N. V. Viswanathan, Jayadev, Sreedhar, New Age Int. Publishers, 4th Edition, 2021
22. Engineering Chemistry, P. C. Jain & Monica Jain, Dhanpat Rai Publication, 2015-16th Edition.
23. Nanostructured materials and nanotechnology, Hari Singh, Nalwa, academic press, 1st Edition, 2002.
24. Nanotechnology Principles and Practices, Sulabha K. Kulkarni, Capital Publishing Company, 3rd Edition 2014
25. Principles of nanotechnology, Phanikumar, Scitech publications, 2nd Edition, 2010.
26. Chemistry for Engineering Students, B. S. Jai Prakash, R. Venugopal, Sivakumaraiah & Pushpalyengar., Subash Publications, 5th Edition, 2014
27. "Engineering Chemistry", O. G. Palanna, Tata McGraw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint, 2015.
28. Chemistry of Engineering materials, Malini S, K. S. Anantha Raju, CBS publishers Pvt Ltd.
29. Laboratory Manual Engg. Chemistry, Anupma Rajput, Dhanpat Rai & Co.

Web links and Video Lectures (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-9IbHrDMjHWWWh>
- <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>

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

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

COs and POs Mapping (Individual teacher has to fill up)

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					

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