

Mechanical Engineering and Allied branches(Chemistry group)

CourseTitle:	Applied Chemistry for Mechanical Engineering stream		
CourseCode:	BCHEM202/202	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+10to12Labslots	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)			
Module-1:Energy;Source,ConversionandStorage(8hr)			
Fuels: Introduction,calorificvalue,determinationofcalorificvalueusingbombcalorimeter, numericalproblemsonGCVandNCV. Greenfuels: Introduction,poweralcohol,synthesisandapplicationsofbiodiesel. High energy fuels: Production of hydrogen by electrolysis of water and its advantages. Energy devices: Introduction, construction, working, and applications of Photovoltaic cells,Li-ionbatteryandmethanol-oxygen fuelcell. Self-learning: Plasticrecyclingtofuelsandits monomersorotherusefulproducts.			
Module-2:CorrosionScienceandEngineering(8hr)			
Corrosion: Introduction,electrochemicaltheoryofcorrosion,typesofcorrosion-differential metal, differential aeration (waterline and pitting),stress corrosion (causticembrittlement). Corrosioncontrol: Metalcoating-galvanization,surfaceconversioncoating-anodizationand cathodic protection-sacrificial anode method. Corrosion testing by weight loss method.Corrosionpenetrationrate (CPR)-numericalproblems. Metalfinishing: Introduction,technologicalimportance.Electroplating:Introduction,			

1.NOTE: Whereverthecontacthoursarenotsufficient,tutorialhours canbeconvertedto theoryhours.

Electroplating of chromium (hard and decorative). Electroless plating: Introduction, electroless plating of nickel.

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

Module-3: Macromolecules for Engineering Applications (8hr)

Polymers: Introduction, methods of polymerization (Condensation and Free radical), molecular weight; number average and weight average, numerical problems. Synthesis, properties and industrial applications of polyvinyl chloride (PVC) and polystyrene.

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 nano-tubes as fillers) and metal matrix polymer composites.

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

Self-learning: Biodegradable polymer: Introduction, synthesis, properties and applications of polylactic acid (PLA).

Module-4: Phase Rule and Analytical Techniques (8hr)

Phase rule: Introduction, Definition of terms: phase, components, degree of freedom, phase rule equation. Phase diagram: 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: Determination of viscosity of biofuel and its correlation with temperature.

Module-5: Materials for Engineering Applications (8hr)

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

Ceramics: Introduction, classification based on chemical composition, properties and applications of perovskites (CaTiO_3).

Nanochemistry: Introduction, size-dependent properties of nanomaterial (surface area, catalytic and thermal), synthesis of nanoparticles by sol-gel, and co-precipitation method. **Nanomaterials:** Introduction, properties and engineering applications of carbon nanotubes and graphene.

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

PRACTICAL MODULE

A-Demonstration (any two) offline/virtual:

A1. Synthesis of polyurethane

A2. Preparation of urea formaldehyde resin A

3. Synthesis of iron oxide

nanoparticles A4. Determination of acid value of biofuel

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

- B1. Conductometric estimation of acid mixture
 B2. Potentiometric estimation of FA using $K_2Cr_2O_7$
 B3. Determination of pKa 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 (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. 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 percentage of iron in steel
 D2. Electroplating of desired metal on substrate
 D3. Synthesis of biodiesel
 D4. Synthesis of Aluminium Oxide nanoparticle

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 processes associated with chemical substances in multidisciplinary 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.Groukrishana,VikasPublishing
7. ATextbookofEngineeringChemistry,SSDara&Dr.SSUmare,SChand&CompanyLtd., 12th Edition, 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,andApplications,MaxLu,FrancoisBeguine,ElzbietaFrackowiak,Wiley-VCH;1stedition,2013.
15. "HandbookonElectroplatingwithManufactureofElectrochemicals",ASIAPACIFICBUSINESSPRESS Inc., 2017. Dr.H. Panda,

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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. Gowariker, 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 & Pushpalayengar, S. ubash Publications, 5th Edition, 2014
27. "Engineering Chemistry", O.G. Palanna, Tata McGraw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint, 2015.

Chemistry of Engineering materials, Malini S, K.S. Anantha Raju, CBS publishers Pvt Ltd.,
28. 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->

28. Laboratory Manual Engg. Chemistry, Anupma Rajput, Dhanpat Rai & Co.
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- <https://www.youtube.com/watch?v=X9GHBdyYcyo>
- <https://www.youtube.com/watch?v=1xWBPZnElk8>
- <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>

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COsandPOsMapping(Individualteacherhastofillup)												
	PO											
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
C01	3	1	1				1					
C02	3	1	1				1					
C03	3	1	1				1					
C04	3	1	1				1					
C05	3	1	1				1					


H.O.D.

Dept. of Agricultural Engineering
Alva's Institute of Engg. & Technology
Mijar, Moodubidire - 574225