

Semester: I					
CHEMISTRY OF SMART MATERIALS AND DEVICES					
Category: Applied Science Course					
Stream: Computer Science (Common to AI, BT, CS, CY, CD & IS Programs)					
(Theory and Practice)					
Course Code	:	CHY211AI		CIE	: 100 Marks
Credits: L:T:P	:	3:0:1		SEE	: 100 Marks
Total Hours	:	42L+ 30P		SEE Duration	: 3 Hours

Unit-I	08 Hrs
Sustainable chemistry and E-waste management: Biomaterials: Introduction, bio-degradable and bio-compatible polymeric materials: synthesis and applications (Polymers and hydrogels in drug delivery). Green Chemistry: Introduction, 12 principles with real life examples, validation of greenness. E-waste: Hazards and toxicity, segregation and recycling (Hydrometallurgy, pyrometallurgy and direct recycling). Extraction of valuable metals from E-waste. Battery waste management and recycling, circular economy- case studies.	
Unit – II	08 Hrs
Computational chemistry: Scope, cost and efficiency of computational modeling. Stabilizing interactions: Bonded and non-bonded interactions. Molecular topology, topological matrix representation, topological indices, QSAR/QSPC concept for insilico prediction of properties. 3D co-ordinate generation for small molecules, geometry optimization.	
Unit –III	08 Hrs
Materials for memory and display technology: Materials for memory storage: Introduction to materials for electronic memory, classification (organic, polymeric and hybrid materials), manufacturing of semiconductor chips. Green computing: Bio-composite based memory devices. Fabrication of smart materials and devices: photo and electro active materials for memory devices, materials for display technology (Liquid crystals display, organic light emitting diode and light emitting electrochemical cells).	
Unit –IV	09 Hrs
Smart sensors and devices RFID and IONT materials: Synthesis, properties and applications in logistic information, intelligent packaging systems (Graphene oxide, carbon nanotubes (CNTs) and polyaniline). Sensors: Introduction, types of sensors (Piezoelectric and electrochemical), nanomaterials for sensing applications (Strain sensors, gas sensor, biomolecules and volatile organic compounds).	
Unit-V	09 Hrs
Advanced energy systems Battery technology: Introduction to electrochemistry, characteristics of battery, Lithium-ion battery metal air batteries. Battery technology for e-mobility. Super capacitors: Storage principle, types (EDLC, pseudo and asymmetric capacitor) with examples and applications. Photovoltaics: Inorganic solar cells, organic solar cells, quantum dot sensitized (QDSSC's). Green hydrogen	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the materials, conventional & non-conventional energy systems for engineering applications.
CO2	Investigate chemical properties of materials for various technological applications.
CO3	Apply the knowledge of material property and energy to analyze environmental issues.
CO4	Develop solutions in the areas of applied materials and energy systems for sustainable engineering application.

Reference Books	
1	E-waste recycling and management: present scenarios and environmental issues, Khan, Anish, and Abdullah M. Asiri. 2019, Springer, Vol. 33. ISBN: 978-3-030-14186-8.
2	Essentials of computational chemistry: theories and models, Christopher J Cramer, 2013, John Wiley & Sons. ISBN: 978-0-470-09182-1.
3	Energy storage and conversion devices: Supercapacitors, batteries and hydroelectric cells, Anurag Gaur, A. L. Sharma, Anil Arya. 2021, CRC press, 1 st edition, ISBN: 978-1-003-14176-1.
4	Fundamentals of analytical chemistry: An introduction, Douglas A. Skoog et al., 2004 Thomson Asia pte Ltd., 8 th , ISBN: 978-0-495-55828-6
E-books	
5	Functional and smart materials, Chander Prakash, Sunpreet Singh, J. Paulo Davim, 2020, CRC Press, ISBN: 978-036-727-510-5.
6	Electrical and electronic devices, circuits and materials: Technological challenges and solutions. Tripathi, S. L., Alvi, P. A., & Subramaniam, U, 2021, John Wiley & Sons, ISBN: 978-0367564261.

Laboratory Experiments	
1	Estimation of copper from PCB.
2	Determination of total acidity of the soft drinks using pH sensors.
3	Potentiometric estimation of iron.
4	Conductometric estimation.
5	Determination of viscosity coefficient of a given liquid using Ostwald's viscometer.
6	Flame photometric estimation of sodium.
7	Colorimetric estimation of copper from E-waste.
8	Electroplating of copper.
9	Synthesis and fabrication of conducting polyaniline and its application in gas sensing (Demonstration experiment).
10	Study the surface morphology of nanomaterials using scanning electron microscopy (Demonstration experiment).
11	Fabrication of thin-film gas sensors using spin coating and electro-spinning technique (Demonstration experiment).
12	Separation of organic compounds using column chromatographic technique and monitoring by thin layer chromatographic technique (Demonstration experiment).
13	Synthesis of metal oxide nanomaterials using solution combustion synthesis.
14	Green synthesis of nanomaterials.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY WITH LAB)		
#	COMPONENTS	MARKS
1	QUIZZES: Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. THE AVERAGE OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.	10
2	TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks. FINAL TEST MARKS WILL BE REDUCED TO 30 MARKS.	30
3	EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) ADDING UPTO 30 MARKS.	30
4	LAB: Conduction of laboratory exercises, lab report, observation and analysis (30 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE REDUCED TO 30 MARKS	30
MAXIMUM MARKS FOR THE CIE THEORY		100

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	CONTENTS	MARKS
PART A		
1	Objective type questions covering entire syllabus	10
PART B (Maximum of TWO Sub-divisions only)		
2	Unit 1 : (Compulsory)	14
3 & 4	Unit 2 : Question 3 or 4	14
5 & 6	Unit 3 : Question 5 or 6	14
7 & 8	Unit 4 : Question 7 or 8	14
9 & 10	Unit 5 : Question 9 or 10	14
11	Lab Component (Compulsory)	20
MAXIMUM MARKS FOR THE SEE THEORY		100