

**VIT**Vellore Institute of Technology
(Established by the University under section 3 of UGC Act, 1956)

REG. NO.:

**SCHOOL OF ADVANCED SCIENCES
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2026-2027**

SLOT: B1+TB1

Programme Name & Branch : B. Tech. Computer Science and Engineering
Course Code and Course Name : BACHY105 (Applied Chemistry)
Faculty Name(s) : Karthikeyan S, Rajagopal D, Sumathi S, Asharani I V, Mohana Roopan S, Satish Kumar G, Sheela A, Vijayalakshmi U, Akhila Maheswari M, Kamini Mishra, Tamalika Ash, Palanisami N, Shanmugam R
Class Number(s) : VL2026270105043, 5099, 5122, 5132, 5139, 5150, 5198, 5214, 5249, 5251, 5268, 7142, 7151
Date of Examination : 28/09/2026
Exam Duration : 90 minutes **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes:

CO2: Use chemical concepts for the advancement of materials in electrical, magnetic, and energy domains.

CO3: Demonstrate UV Visible spectroscopic and X-ray diffraction techniques.

QN	Question	M	CO	BL
1.	(a) A hydrogen-oxygen electrochemical power source is proposed for use in space vehicles. Identify the type of fuel cell and explain why it is particularly suitable for space-vehicle applications. With a neat diagram, explain the construction and working mechanism, indicating the movement of the ions and electrons through the cell. Write the anodic, cathodic, and overall electrochemical reactions involved. (b) A nickel electrode is immersed in a 0.5 M Ni^{2+} solution and a silver electrode in a 0.01 M Ag^+ solution. The standard reduction potentials of Ni^{2+}/Ni and Ag^+/Ag are -0.25 V and $+0.80\text{ V}$, respectively. - Write the cell representation. - Write the oxidation and reduction half-cell reactions. - Calculate the cell potential (E_{cell}) at 25°C using the Nernst equation.	5+5	2	3
2.	A rechargeable electrochemical cell employed in electric vehicles and renewable-energy storage systems operates through the reversible movement of a light metal species between two layered host structures. Using a suitable diagram, analyse the ion and electron transport mechanism, formulate the electrode and overall charge-discharge reactions, and justify how the layered host structures facilitate reversible cycling and high energy density.	10	2	3
3	A semiconductor-based photoelectrochemical device incorporates a	10	2	2



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	photosensitizer to extend the semiconductor's light-absorption range. Design a suitable photoelectrochemical system with a neat diagram and explain the function of each component; illustrate the sequence of events from light absorption by the photosensitizer to charge separation, charge transport, and current generation, and critically explain how these processes enable efficient production of electricity.			
4	Analyse why nanostructuring can result in electrical and optical properties that differ significantly from those of the corresponding bulk material, and discuss the factors responsible for these changes. Using a bottom-up approach, design a suitable synthetic route for nanoscale silica, illustrating the reaction equations and key processing steps involved in controlling its size and morphology, and critically evaluate the advantages and limitations of the chosen method.	10	2	2
5	(a) A series of organic compounds exhibits different absorption characteristics when interacting with electromagnetic radiation. Explain the fundamental principle of the appropriate spectroscopy. Using Congo red and methylene blue as representative coloured compounds, compare their absorption patterns and account for their intense colours in terms of chromophores, auxochromes, extent of conjugation, and the electronic transitions involved. Relate the molecular structures of these compounds to their characteristic absorption in the visible region. (b) A crystalline material gives a diffraction peak at $2\theta = 44.60^\circ$ with an FWHM of 0.95° when analysed using X-rays of energy 6.93 keV. Taking the shape factor, $k = 0.9$, determine the X-ray wavelength and the average crystallite size using the Scherrer equation, and critically comment on the significance of the calculated crystallite size in relation to the material's nanoscale properties. Given: $h = 6.626 \times 10^{-34} \text{ J s}$, $1\text{eV} = 1.602 \times 10^{-19} \text{ J}$.	5+5	3	3
