

CBCS SCHEME

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1BCHEM102/202



First/Second Semester B.E./B.Tech. Degree Examination, June/July 2026

Applied Chemistry for Advanced Metal Protection and Sustainable Energy Systems (ME)

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. M : Marks, L: Bloom's level, C: Course outcomes.

3. VTU Formula Hand Book is permitted.

			M	L	C
Module – 1					
Q.1	a.	Distinguish between differential metal corrosion and differential aeration corrosion with one suitable example.	6	L2	CO1
	b.	Explain the anodization process as a surface conversion coating technique for corrosion control. What are its advantages over conventional painting?	7	L2	CO1
	c.	What is electroless plating? Describe the electroless plating of Nickel with the chemical reactions involved. How does it differ from electroplating?	7	L2	CO1
OR					
Q.2	a.	Explain the sacrificial anode method of cathodic protection for corrosion control. Mention their applications in engineering.	6	L2	CO1
	b.	Discuss electrochemical theory of corrosion by taking Fe as an example.	7	L2	CO1
	c.	Define Corrosion Penetration Rate (CPR). A steel plate (density = 7.9 g/cm ³) of area 120 in ² was exposed to a marine environment for 18 months and experienced a weight loss of 420 g. Calculate the CPR in: (a) mpy (b) mm/year. (Given: K = 534 for mpy, K = 87.6 for mm/y).	7	L3	CO1
Module – 2					
Q.3	a.	Define octane and cetane numbers. Explain their significance in the performance of petrol and diesel engines respectively.	6	L2	CO2
	b.	What are anti-knocking agents? Explain the role of MTBE and ETBE as anti-knocking agents.	7	L2	CO2
	c.	What is biodiesel? Explain the synthesis of biodiesel by the transesterification method with a neat reaction scheme. Mention its applications as a green fuel.	7	L2	CO2

OR

Q.4	a.	0.85 g of a coal sample containing 3.0% hydrogen was subjected to combustion in a bomb calorimeter. The mass of water in the calorimeter was 1200 g and the water equivalent of the calorimeter was 400 g. The rise in temperature was 2.6°C. Calculate the GCV and NCV of the fuel. (Specific heat of water = 4.2 kJ/kg°C; Latent heat of steam = 2454 kJ/kg)	6	L3	CO2
	b.	Explain hydrogen storage using metal hydrides and ammonia as chemical hydrogen carriers. Discuss the advantages and limitations of each method.	7	L2	CO2
	c.	What is power alcohol? Describe its properties, applications as a fuel. How does blending power alcohol with petrol improve fuel efficiency?	7	L2	CO2

Module – 3

Q.5	a.	What is graphene? Explain the synthesis of graphene by the Chemical Vapor Deposition (CVD) method. Mention its important engineering applications.	6	L2	CO3
	b.	Explain the construction, working and applications of a Solid Oxide Fuel Cell (SOFC). How does it differ from a battery?	7	L2	CO3
	c.	Describe the characteristics of batteries: capacity, power density, shelf life and cycle life with example.	7	L2	CO3

OR

Q.6	a.	Explain the synthesis of TiO ₂ nanoparticles by the sol-gel method. Discuss its uses.	6	L2	CO3
	b.	Explain the size-dependent properties of nanomaterials with respect to: (i) surface area, (ii) catalytic property, (iii) electrical conductivity, and (iv) thermal conductivity.	7	L2	CO3
	c.	Explain the construction and working of a Li-ion battery with cell reactions and neat diagram.	7	L2	CO3

Module – 4

Q.7	a.	Explain the structure-properties relationship of polymers with reference to: (i) crystallinity, (ii) strength, and (iii) elasticity.	6	L2	CO4
	b.	In a polymer sample, 25% of molecules have molecular mass 8,000 g/mol; 45% have molecular mass 18,000 g/mol; and the remaining have molecular mass 30,000 g/mol. Calculate the number average and weight average molecular masses of the polymer.	7	L3	CO4
	c.	Explain the preparation of carbon fiber from Polyacrylonitrile (PAN). Discuss the important industrial applications of carbon fiber in mechanical engineering.	7	L2	CO4

OR

Q.8	a.	What is glass transition temperature (T_g)? Explain the factors that affect T_g and discuss its significance in the selection of engineering polymers.	6	L2	CO4
	b.	Explain the synthesis, properties and engineering applications of Polymethyl Methacrylate (PMMA). Why is it preferred over glass in many applications?	7	L2	CO4
	c.	What is a fiber-reinforced polymer (FRP)? Explain the synthesis of Kevlar, its important properties, and industrial applications in mechanical engineering.	7	L2	CO4
Module – 5					
Q.9	a.	In a COD test, 30.0 cm ³ and 16.5 cm ³ of 0.05 N FAS solution were required for blank and sample titration respectively. The volume of the test sample used is 25 cm ³ . Calculate the COD of the sample solution.	6	L2	CO4
	b.	What are lubricants? Classify lubricants with examples. Explain the ideal properties required of a good lubricant used in high-speed mechanical systems.	7	L3	CO4
	c.	Explain the principle of a pH sensor (glass electrode) and its application in the estimation of pK _a of an acid electrolyte.	7	L2	CO4
OR					
Q.10	a.	Define coolants? Briefly classify coolants types. Explain their properties and industrial applications in machining operations.	6	L2	CO4
	b.	Describe the experimental determination of viscosity coefficient of a lubricant using Ostwald's viscometer. Mention the significance of viscosity in lubricant selection.	7	L2	CO4
	c.	Explain the principle of a potentiometric sensor and its application in the estimation of iron in steel industry effluent with a neat diagram of the potentiometric cell setup.	7	L2	CO4
