U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**

Branch: Chemical Engineering **Duration: 3 hrs.**

Course Code: 23CY3ESMCA / 22CY3ESMCA **Max Marks: 100**

Course: Materials Chemistry and Applications

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Discuss the importance of the radius ratio in crystal structure. Obtain the limiting radius ratio for coordination number 3.	CO2	PO2	**7**
	b)	Discuss the linear combination of atomic orbitals (LCAO). What are the conditions for the combination of atomic orbitals to form molecular orbitals?	CO1	PO1	**7**
	c)	What are secondary bonds? Explain intra-molecular and inter-molecular hydrogen bonding with an example.	CO2	PO2	**6**
		OR			
2	a)	What is lattice energy? Derive Born-Lande equation for the calculation of lattice energy of solids.	CO1	PO1	**7**
	b)	Discuss (i) ion-dipole, and (ii) dipole – induced dipole interactions with examples.	CO2	PO2	**7**
	c)	Which has a longer bond: O_2^{-1} or O_2? Explain your response using molecular orbital theory.	CO1	PO1	**6**
		UNIT - II			
3	a)	Deduce Braggs' law for diffraction of X-ray by crystals. Justify that visible light cannot used for diffraction of crystals.	CO2	PO2	**7**
	b)	Discuss metal excess defects in crystals. How does it differ from the Frenkel defect?	CO2	PO2	**7**
	c)	A beam of X-rays of wavelength 0.71 Å is diffracted by (1 0 0) plane of rock salt (FCC) with lattice constant of 2.4 Å. Find the glancing angle for the first-order diffraction.	CO2	PO2	**6**
		OR			
4	a)	Elaborate on edge and screw dislocations.	CO1	PO1	**7**
	b)	Discuss the construction and working of transmission electron microscope.	CO1	PO1	**7**
	c)	Determine the miller indices for the planes that intersect the crystallographic axis at the distances (2a, 3b, -2c) and (2a, b, ∞c).	CO2	PO2	**6**
		UNIT - III			
5	a)	Explain the reactant and product selectivity of zeolite catalysts using relevant examples.	CO3	PO3	**7**

		b)	Give examples of bifunctional catalysts. Explain the role of bifunctional catalyst in steam reforming.	*CO3*	*PO3*	**7**
		c)	Describe the mechanism of an acid-catalyzed reaction with a relevant example.	*CO1*	*PO3*	**6**
			OR			
	6	a)	Explain the role of catalysts in catalytic converters.	*CO3*	*PO3*	**7**
		b)	What are organometallic catalysts? Explain the mechanism of the catalytic alkene isomerization reaction.	*CO1*	*PO1*	**7**
		c)	What properties make zeolites suitable for catalytic applications? Discuss.	*CO2*	*PO2*	**6**
			UNIT - IV			
	7	a)	Explain the lead-tin phase diagram. What is the eutectic point?	*CO1*	*PO1*	**7**
		b)	What is Nernst distribution law? Discuss any three applications.	*CO2*	*PO2*	**7**
		c)	State the Gibbs phase rule. Explain (i) Eutectic mixture and, (ii) Eutectic reaction.	*CO1*	*PO1*	**6**
			OR			
	8	a)	Describe the phase diagram of single-component iron. What is a triple point?	*CO1*	*PO1*	**7**
		b)	What are azeotropes? Explain (i) low boiling, and (ii) high boiling azeotropes with examples.	*CO2*	*PO2*	**7**
		c)	Elaborate on steam distillation. What are its applications?	*CO3*	*PO3*	**6**
			UNIT - V			
	9	a)	Explain the manufacturing, composition, and applications of soda glass.	*CO3*	*PO3*	**7**
		b)	Explain thin film and thick film lubrication.	*CO1*	*PO1*	**7**
		c)	Discuss the composition and applications of any two copper alloys.	*CO3*	*PO3*	**6**
			OR			
	10	a)	What is viscosity index? An oil of unknown viscosity index has a viscosity of 70 Pa.s at 210 °F and 580 Pa.s at 100 °F. The high-viscosity index standard (i.e., Pennsylvanian oil) has a viscosity of 70 Pa.s at 210 °F and 600 Pa.s at 100 °F. The low-viscosity index standard (Gulf oil) has a viscosity of 70 Pa.s at 210 °F and 700 Pa.s at 100 °F. Calculate the viscosity index of the unknown oil.	*CO2*	*PO2*	**7**
		b)	Elaborate on the composition and applications of (i) borosilicate glass, and (ii) optical glass.	*CO3*	*PO3*	**7**
		c)	Discuss the role of various elements found in steel.	*CO1*	*PO1*	**6**

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