Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- VII EXAMINATION-SUMMER 2023

Subject Code: 3170509 Date: 26/06/2023

Subject Name: Nanoscience and Technology

Time: 10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Define nanotechnology. Who introduced the concept of nanotechnology? What is the relationship between nanometer and micrometer?	**03**
	(b)	State and explain two important properties that differentiate nanomaterials from bulk materials.	**04**
	(c)	Explain how the synthesis of nanomaterials can be carried out by lithographic process. Can lithography be considered as a combination of top down and bottom up approach? Why?	**07**
Q.2	**(a)**	Give Examples of the following i) Oxide nanomaterial used in self-cleaning glass. ii) combination of top down and bottom up approach, iii) point defects of ionic solids	**03**
	(b)	State with examples surface chemistry and its effect on catalytic activities of nanomaterials.	**04**
	(c)	How do the concepts of quantum physics and chemistry help in understanding the unique physico-chemical behavior of material at nanoscale?	**07**
		OR	
	(c)	Discuss colour generation from nanoparticles and nanostructures due to interaction with light or other reasons with examples.	**07**
Q.3	**(a)**	Explain the role of reducing agents and stabilizers in colloidal method of synthesis of nanoparticles.	**03**
	(b)	State different stages of mechanism of nanocrystallite nanostructure formation during high energy ball milling. Name three materials used as MOC for vials and balls in a planetary ball mill.	**04**
	(c)	Explain the effect of nanometer length scale on diffusivity, melting point and solubility of materials.	**07**
		OR	
Q.3	**(a)**	State and explain various modes of nucleation in the deposition of thin film.	**03**
	(b)	Compare CVD and PVD methods of synthesis of nanomaterials.	**04**
	(c)	Explain various steps of chemical vapor deposition (CVD) process for synthesis of nanomaterials.	**07**

Q.4	**(a)**	Explain the principle of molecular self-assembly of synthesis of nanomaterials in brief.	**03**
	(b)	Sol-gel method of synthesis of nanomaterials consists of two steps: hydrolysis and condensation. During hydrolysis, the alkoxy group OR is replaced by hydroxo ligands (OH). State two governing factors of hydrolysis. Write the generic name of the two reactions which lead to condensation. Name the most commonly studied metal-alkoxide precursor for the synthesis of silica aerogel.	**04**
	(c)	Discuss the application of nanomaterials in catalysis.	**07**
		OR	
Q.4	**(a)**	Mixed metal oxide (Fe-oxide and Zn-oxide) nanoparticles have been synthesized in the laboratory. Suggest suitable analytical methods to (i) find out degree of crystallinity (ii) surface texture. Further a dispersion of the as-prepared metal oxide is applied as a coating on a membrane surface. Which analytical method would you suggest to know the surface roughness of the membrane? (Avoid writing abbreviated names)	**03**
	(b)	Explain the principle and working of dynamic light scattering method.	**04**
	(c)	Explain Beer-Lambert law in context with UV-VIS spectroscopy. State three important applications of UV-VIS spectroscopy.	**07**
Q.5	**(a)**	State and explain Bragg's law for X-ray diffraction analysis.	**03**
	(b)	Explain the principle of FTIR analysis. Which type of spectral information can be obtained from FTIR analysis?	**04**
	(c)	Explain the working principle of Scanning electron microscopy.	**07**
		OR	
Q.5	**(a)**	What is EDS analysis? State its application.	**03**
	(b)	Briefly explain the application of nanotechnology in drug delivery and diagnostics	**04**
	(c)	Compare and contrast the salient features of scanning electron microscopy and transmission electron microscopy.	**07**

****