Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2021**

**Subject Code:3170509 Date:15/12/2021**

**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)** | What is the relation between nanometer and micrometer? Give one example each of zero, one and two dimensional nanomaterials. | **03** |
| | **(b)** | Compare and contrast the features of top-down and bottom up approaches of synthesis of nanomaterials | **04** |
| | **(c)** | Discuss the principle of lithographic process with schematic diagram. Can lithography be considered as a combination of top down and bottom up approach? Why? | **07** |
| **Q.2** | **(a)** | Why are the nanoparticles inherently unstable? How do they attain stability? | **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)** | 0.2 M aqueous solution of 'A' is mixed with 0.4 M of a strong alkali 'B' at room temperature under vigorous stirring condition. 'A' is a hexa-hydrated salt of a heavy metal and a white crystalline solid. 'B' is a hydroxide of silvery white alkali metal which is soft enough to be cut with a knife and produces beautiful lilac color flame. The reaction results in the formation of a white suspension 'C' of a compound which is centrifuged followed by washing with water and calcined at 500$^{o}$C for 3 h. The resultant white color nanoparticles of compound (D) have strong antifungal characteristics. Thermal decomposition of 'A' would also yield 'D' along with a dark brown color gas (E). D is an important ingredient of sunscreen cream. Identify A to E with justifications and reactions. | **07** |
| **Q.3** | **(a)** | 'The size of metallic colloids varies significantly with the type of reducing agents'- explain. | **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 drug delivery and diagnostics. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | What are the major types of spectroscopy? Give examples for each. | **03** |
| | **(b)** | State and explain Stokes-Einstein relation in the context to dynamic light scattering (DLS) method for particle size distribution. | **04** |
| | **(c)** | Explain Beer-Lambert law in context with UV-VIS spectroscopy. State three important applications of UV-VIS spectroscopy. | **07** |
| **Q.5** | **(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 of FTIR analysis. Which type of spectral information can be obtained from FTIR analysis? | **04** |
| | **(c)** | Compare and contrast the salient features of scanning electron microscopy and transmission electron microscopy. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | What is EDS analysis? State its application. | **03** |
| | **(b)** | Explain photocatalysis using nanomaterials photocatalysts such as titanium oxide for water purification. | **04** |
| | **(c)** | Discuss any one method of the synthesis of carbon nanotubes (CNT). Write down important applications of CNT. | **07** |

****************

Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2022**

**Subject Code:3170509 Date:08/06/2022**

**Subject Name:Nanoscience and Technology**

**Time:02:30 PM TO 05:00 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)** | Write down three unique features of a nanomaterial. What is the relationship between nanometer and micrometer? | **03** |
| | **(b)** | State advantages and disadvantages of top-down and bottom-up methods of synthesis of nanomaterials. | **04** |
| | **(c)** | Discuss the principle of lithographic process with schematic diagram. Can lithography be considered as a combination of top down and bottom up approach? Why? | **07** |
| **Q.2** | **(a)** | Why are the nanoparticles inherently unstable? How do they attain stability? | **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 the role of nanomaterials in advances on catalysis. | **07** |
| **Q.3** | **(a)** | 'The size of metallic colloids varies significantly with the type of reducing agents'- explain. | **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)** | Discuss briefly the principle of Sol-gel method of synthesis of nanomaterials. | **04** |
| | **(c)** | Discuss the application of nanomaterials in drug delivery and diagnostics. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | List out the major types of spectroscopy? Give examples for each. | **03** |

| | | | |
|---|---|---|---|
| | **(b)** | State and explain Stokes-Einstein relation in the context to dynamic light scattering (DLS) method for particle size distribution. | **04** |
| | **(c)** | Explain Beer-Lambert law in context with UV-VIS spectroscopy. State three important applications of UV-VIS spectroscopy. | **07** |
| **Q.5** | **(a)** | Explain the principle of 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)** | Compare and contrast the salient features of scanning electron microscopy and transmission electron microscopy. | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | What is EDS analysis? State its application. | **03** |
| | **(b)** | Explain photocatalysis using nanomaterials photocatalysts such as titanium oxide for water purification. | **04** |
| | **(c)** | Discuss any one method of the synthesis of carbon nanotubes (CNT). Write down important applications of CNT. | **07** |

****************