	Utech
Name:	(4)
Roll No.:	The Owner of Exemplify and Excitors
Invigilator's Signature :	

NANOTECHNOLOGY

Time Allotted: 3 Hours Full Marks: 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP - A

(Multiple Choice Type Questions)

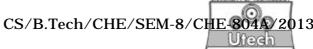
- 1. Choose the correct alternatives for any ten of the following : $10 \times 1 = 10$
 - i) Silver nanoparticles are used in
 - a) Car paints
 - b) Medicinal bandages
 - c) Sporting goods
 - d) Sunscreens.
 - ii) The FCC crystal structure
 - a) has 5 atoms/molecule on each face
 - b) has 4 atoms/molecule on each face
 - c) is found in amorphous solids
 - d) is rarely found in nature.

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iii) Optical microscopy is based on the principle of

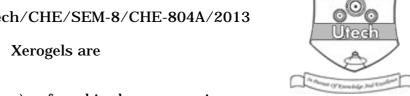
- a) light diffraction
- b) a pulsed laser
- c) light transmission through a dichoric mirror
- d) is not applicable for particles > 0.2 microns.
- iv) Ratio of surface area to volume
 - a) increases as objects get smaller
 - b) decreases as objects get smaller
 - c) has no relation with the size of the object
 - d) none of these.
- v) Steric repulsion in colloids
 - a) exists between macromolecules in a colloid
 - b) only exists between charged particles
 - c) is a function of electrostatic double layer repulsion
 - d) exists in organic solvents.

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- vi) Silicon is a/an
 - a) direct band-gap semiconductor
 - b) intrinsic and direct band-gap semiconductor
 - c) intrinsic and indirect band-gap semicoductor
 - d) extrinsic and direct band-gap semiconductor.
- vii) Amphiphillic molecules
 - a) are found in oil water emulsions
 - b) are water loving molecules
 - c) are found in soaps and detergents
 - d) can separate water and oil layer.
- viii) Langmuir-Blogett process
 - a) is a film deposition process
 - b) is used in microemulsions
 - c) is a bottom-up film deposition process
 - d) is used for micellar reactions.

ix)



- found in dense ceramics a)
- can by sprayed or spin coated on a substrate b)
- are similar to aero gels c)
- are obtained by evaporations of gel structure. d)
- Atomic force microscope tips are generally made of x)
 - Silicon a)
 - Germanium b)
 - Platinum c)
 - Tungsten. d)
- Fullerenes are xi)
 - carbon nanotubes a)
 - b) a form of carbon
 - same as graphite c)
 - are non-carbonaceous material. d)

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- xii) Dendrimers are
 - a) essentially polymers
 - b) branched monomers
 - c) monolithic structures
 - d) none of these.

GROUP - B (Short Answer Type Questions)

Answer any *three* of the following.

 $3 \times 5 = 15$

- Draw a labelled diagram of the Langmuir-Schaeffer process.
 Explain self-assembly with reference to this process.
- Explain the significant difference between molecular beam epitaxy and sputter deposition process. Give examples of two processes.
- 4. What is plasma? How is it advantageous to use plasma in combination with other film deposition techniques?

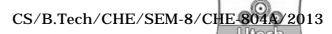
- 5. Explain with one example, how biological templates are used for nanomaterial deposition.
- 6. What is porous silicon? How is it different from ordinary silicon?

GROUP - C (Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

- 7. Explain with a labelled diagram the principle behind AFM and give examples of its applications. What are the three modes of operation of AFM ? What is phototunnelling ?
- 8. Explain the process of soft lithography. With examples, describe the process difference between microcontact printing and microtransfer molding.
- 9. Describe with a diagram two predominant processes by which CNTs are manufactured. What are the different types of carbon nanotube structures found? Draw a diagram for each.

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10. Explain two nano-lithography processes. What are some of the special applications of each process?

11. What are linkers and spacers? Explain with examples.

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