

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

**DEPARTMENT
OF
ELECTRICAL AND ELECTRONICS ENGINEERING**

QUESTION BANK



VI SEMESTER

1920001 – FUNDAMENTALS OF NANO SCIENCE

Regulation – 2019

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SUBJECT : 1920001 - FUNDAMENTALS OF NANO SCIENCE
SEM / YEAR : VI / III

UNIT I - INTRODUCTION

Nano scale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- Nano particles- quantum dots, nanowires-ultra-thin films multi-layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

PART - A

S.No	Questions	BT Level	Competence
1.	Name any four types of nanostructured materials.	BTL 1	Remember
2.	What do you mean by NANO?	BTL 4	Analyze
3.	List the application of quantum dots.	BTL 1	Remember
4.	Define nanomaterials.	BTL 1	Remember
5.	What do you mean by nanoparticles?	BTL 2	Understand
6.	Define Nanoscience and Nanotechnology.	BTL 1	Remember
7.	What are one dimensional nanomaterial?	BTL 4	Analyze
8.	Give the applications of nanowires.	BTL 2	Understand
9.	How does the mechanical property of material vary in nano regime?	BTL 4	Analyze
10.	What do you mean by nanowires?	BTL 2	Understand
11.	Define Quantum dots.	BTL 1	Remember
12.	Why do nano particles exhibit a low melting point when compared to the respective bulk materials?	BTL 2	Understand
13.	Write any four properties of nanowires.	BTL 6	Create
14.	Identify any three applications of thin films.	BTL 3	Apply
15.	Demonstrate any four day to day live commercial applications of nanotechnology.	BTL 3	Apply
16.	Nano particle of gold is purple in colour. Justify.	BTL 5	Evaluate
17.	What is meant by multi layered materials?	BTL 3	Apply
18.	How does the optical property of material vary in nano regime?	BTL 5	Evaluate
19.	Generalize the effects of length scale of nanomaterials on magnetic properties.	BTL 6	Create
20.	Why do nano particles exhibit a low melting point when compared to the respective bulk materials?	BTL 1	Remember
21.	Classify the nano structured materials.	BTL 2	Understand
22.	Examine about the types of nano wires.	BTL 3	Apply
23.	Analyze the various conditions involved in synthesis of Nano Wires.	BTL 4	Analyze
24.	Express 5nm in terms of equivalent μm	BTL 5	Evaluate
PART B			
1.	Describe about the implications of Nano science in the field of (i) Physics (7) (ii) Chemistry. (6)	BTL 1	Remember

2.	Describe the effects of nanotization on the properties of materials. (13)	BTL 1	Remember
3.	Distinguish the properties and synthesis methods of Nano particles and Quantum dots. (13)	BTL 2	Understand
4.	Describe about the implications of Nano science and technology for (i) Biology (7) (ii) Engineering. (6)	BTL 1	Remember
5.	Discuss in detail about the following properties of Nano particles. (i) Mechanical (7) (ii) Electronics. (6)	BTL 2	Understand
6.	Generalize the effects of length scales involved and effect on properties in nanoparticles. (13)	BTL 6	Create
7.	(i) Analyze term Nano phase materials. (3) (ii) Explain how the physical properties vary with geometry. (10)	BTL 4	Analyze
8.	Discuss in detail about the Optical and Thermal properties of Nano particles (13)	BTL 2	Understand
9.	Explain the properties, synthesis methods and applications of (i) Ultra-thin films and (7) (ii) Multi-layered materials. (6)	BTL 5	Evaluate
10.	Describe the plasma arcing method of producing Nano Particles. (13)	BTL 3	Apply
11.	List applications of Nano materials in various Fields. Also explain the method of producing Nano materials using physical vapour deposition techniques. (13)	BTL 4	Analyze
12.	List the factors responsible for change of properties of nano scale material from that of the bulk material. (13)	BTL 1	Remember
13.	Explain the different ways of classifying nanomaterials with examples. (13)	BTL 3	Apply
14.	Explain with necessary diagrams the synthesis of nanomaterials using Chemical Vapour deposition. (13)	BTL 4	Analyze
15.	Summarize the steps involved in synthesis of nanomaterials using Sol-gel method. (13)	BTL 2	Understand
16.	Discuss about the properties involved in nanoparticles. (13)	BTL 3	Apply
17.	With a neat Sketch, Explain the synthesis of Nano wires. (13)	BTL 4	Analyze
PART C			
1.	Discuss about nanomaterials in science and engineering fields. (15)	BTL 6	Create
2.	Elaborate present and future applications of nano particles in industry. (15)	BTL 6	Create
3.	Discuss about the classification of nanostructured materials with suitable examples. (15)	BTL 5	Evaluate
4.	Why surface area/volume ratio is very large for nano particles compared to bulk materials? Highlight the effect of surface area increase on mechanical and optical properties. (15)	BTL 5	Create

5.	Does the material change its properties at nano scale compared to their bulk material?.Elaborate it (15)	BTL 5	Create
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UNIT II - GENERAL METHODS OF PREPARATION

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultra sonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE

PART - A

S.No	Questions	BT Level	Competence
1.	Differentiate bottom-up and Top-down approach.	BTL 2	Understand
2.	Point out the advantages of top-down approach.	BTL 4	Analyze
3.	Analyse self-assembly of nanostructures.	BTL 4	Analyze
4.	State the principle of bottom-up approach with an example.	BTL 1	Remember
5.	Generalize the application of self assembly materials.	BTL 6	Create
6.	What do you meant by Ultra sonication?	BTL 2	Understand
7.	List any four day to day live commercial applications of nanotechnology.	BTL 1	Remember
8.	When does contamination arise in Attritor milling?	BTL 1	Remember
9.	Identify the category to which sol-gel, MBE, ECAP and laser ablation belong to.	BTL 5	Evaluate
10.	Classify the vapour phase deposition methods.	BTL 3	Apply
11.	What do you mean by colloidal routes?	BTL 2	Understand
12.	Classifying the types of Sputtering.	BTL 3	Apply
13.	What is the principle of mechanical milling?	BTL 1	Remember
14.	Why bottom up approaches will be preferred for nano material fabrication?	BTL 4	Analyze
15.	List the applications of milling.	BTL 1	Remember
16.	Compare the term MBE and MOMBE.	BTL 5	Evaluate
17.	Classify the different types of milling.	BTL 4	Analyze
18.	Illustrate the principle of atomic layer Epitaxy.	BTL 3	Apply
19.	What is meant by co-precipitation?	BTL 2	Understand
20.	Define sputtering.	BTL 1	Remember
21.	Write the advantages and disadvantages of MOCVD.	BTL 6	Create
22.	Write the advantages of CVD method?	BTL 2	Understand
23.	Analyze which method of process mostly used for synthesis of nano materials.	BTL 3	Apply
24.	No safety precautions are needed for MBE process. Justify.	BTL 5	Evaluate

PART B

1.	Explain in detail about the working of mechanical milling process and mention its merits and demerits. (13)	BTL 4	Analyze
2.	Discuss the working of molecular beam epitaxy for producing nano materials. (13)	BTL 2	Understand
3.	(i) Differentiate PVD and CVD. (3) (ii) Write notes on Sputtering and mention its advantages and drawbacks. (10)	BTL 4	Analyze
4.	Discuss in detail about Atomic Layer Epitaxy in detail. (13)	BTL 2	Understand
5.	(i) Explain any two methods of chemical synthesis of Nanomaterials. (8) (ii) List their advantages and disadvantages. (5)	BTL 1	Remember

6.	Enumerate the different chemical methods of synthesis of nanomaterials and state its advantages and disadvantages. (13)	BTL 1	Remember
7.	Explain the working of MOCVD in detail. (13)	BTL 4	Analyze
8.	Explain the working of e-beam evaporation with neat sketch. (13)	BTL 5	Evaluate
9.	Illustrate the scheme of the formation of agglomerates from colloidal sols and structural model of Nanomer of inorganic & organic Nanocomposite. (13)	BTL 3	Apply
10.	(i) Generalize the schematic representation of electron beam deposition system. (7) (ii) Create the difference between gas condensation process and vapour condensation process employed for synthesis of Nano powders. (6)	BTL 6	Create
11.	Illustrate in detail about Ultrasonication process. (13)	BTL 3	Apply
12.	Define colloidal routes. Describe in detail about fabrication nanoparticles by simple colloidal process. (13)	BTL 1	Remember
13.	Describe about top down approach in synthesis of nano materials. (13)	BTL 1	Remember
14.	Discuss about the following methods with schematic diagram of (i) RF sputtering. (7) (ii) Reactive sputtering (6)	BTL 2	Understand
15.	With a neat schematic explain in detail about chemical vapour deposition technique. Also mention its advantages and disadvantages. (13)	BTL 2	Understand
16.	Describe in detail about strategies involved in the synthesis of self-assembly. (13)	BTL 3	Apply
17.	Describe the MBE growth technique with a sketch. (13)	BTL 4	Analyze
PART C			
1.	Explain about thermal evaporation in general methods of preparation of nano materials. (15)	BTL 5	Evaluate
2.	Explain the working of MOMBE process with neat sketch. (15)	BTL 6	Create
3.	Discuss the role of bottom up approach in nano technology. (15)	BTL 6	Create
4.	Explain the applications of nano powders in industry. (15)	BTL 5	Evaluate
5.	Explain the bottom –up approach towards synthesis of Nano structured materials. Discuss in detail about any two methods. (15)	BTL 5	Evaluate

UNIT III - NANOMATERIALS

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nano metal oxides-ZnO, TiO₂,MgO, ZrO₂, NiO, nanoalumina, CaO, AgTiO₂, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

PART – A			
S.No	Questions	BT Level	Competence
1.	Define fullerene.	BTL 1	Remember
2.	How are carbon nanotubes classified?	BTL 4	Analyze
3.	What are the methods adopted for producing nano materials?	BTL 4	Analyze
4.	List any four properties of Carbon nanotubes.	BTL 1	Remember
5.	Define graphene.	BTL 1	Remember
6.	Differentiate single wall and multi wall carbon nanotubes.	BTL 4	Analyze
7.	Differentiate carbon nanotubes from bucky balls.	BTL 4	Analyze
8.	Give the features of Nano metal oxides.	BTL 2	Understand
9.	Illustrate the principle of plasma CVD involved in Nano materials.	BTL 3	Apply
10.	What do you mean by CVD routes in nanotubes?	BTL 5	Evaluate
11.	Which methods involved producing Tio ₂ nanoparticles?	BTL 1	Remember
12.	Give a brief note on the applications of laser ablation.	BTL 5	Evaluate
13.	Illustrate the features of CaO Nano materials	BTL 3	Apply
14.	Define ferrites.	BTL 1	Remember
15.	State the applications of ferrites.	BTL 1	Remember
16.	It is desired to synthesize titania nanoparticles of about 2-3 nm in size. Which technique would you choose and also give reason for it.	BTL 6	Create
17.	What do you mean by nanoalumina metal oxides?	BTL 2	Understand
18.	Nano-gold no longer glitters with a golden yellow metallic luster. Why?	BTL 3	Apply
19.	Give a brief note on applications of nanoclays.	BTL 6	Create
20.	Distinguish between Quantum wires and Quantum dots.	BTL 2	Understand
21.	Give a brief note on Carbon nanotube.	BTL 2	Understand
22.	Draw the schematic of Carbon Arc method.	BTL 3	Apply
23.	What do you understand by Nanoclays?	BTL 4	Analyze
24.	Write a note on Buckminster fullerenes.	BTL 5	Evaluate
PART – B			
1.	Explain three different structure of SWCNT and different types of defect in it. (13)	BTL 4	Analyze
2.	Discuss in detail about quantum wires - its preparation, properties and applications. (13)	BTL 6	Create
3.	(i) Discuss about the synthesis of CaO in brief. (7) (ii) Write short note on Buckminster fullerene. (6)	BTL 2	Understand
4.	Describe the principle and different methods of synthesis in nanoparticles. (13)	BTL 1	Remember
5.	Explain the synthesis of the following in brief: a) NiO. (7) b) AgTiO ₂ . (6)	BTL 2	Understand
6.	Explain in detail about Arc growth method. (13)	BTL 5	Evaluate
7.	Give a detailed account of the nano forms of Carbon. (13)	BTL 3	Apply
8.	Discuss about the synthesis of ZrO ₂ in brief. (13)	BTL 2	Understand
9.	Discuss in detail about quantum dots - its preparation, properties and applications. (13)	BTL 1	Remember
10.	Explain the structure-property relationship of nanometal oxides with an example. (13)	BTL 4	Analyze

11.	Describe the different types of ferrite structure with suitable diagrams. (13)	BTL 1	Remember
12.	Illustrate the structure-property relationship of nanoalumina with an example. (13)	BTL 3	Apply
13.	Describe preparation, properties and applications of nanoclays. (13)	BTL 1	Remember
14.	Explain about a) CVD routes. (7) b) Plasma CVD. (6)	BTL 4	Analyze
15.	Discuss about the synthesis of MnO in brief. (13)	BTL 2	Understand
16.	Illustrate about Carbon Nanotube fabrication using Laser ablation technique. (13)	BTL 3	Apply
17.	Explain in detail any two methods of Nano metal oxides. (13)	BTL 4	Analyze
PART C			
1.	Explain the purification of Indian clay in detail. (15)	BTL 5	Evaluate
2.	Discuss about the synthesis of ZnO in brief. (15)	BTL 6	Create
3.	Discuss about the synthesis of TiO ₂ with a block diagram. (15)	BTL 6	Create
4.	Explain different fabrication methods for carbon nanotubes. (15)	BTL 5	Evaluate
5.	In detail discuss the structure-property relationship of nanometal oxides with an example. (15)	BTL 5	Evaluate

UNIT IV- CHARACTERIZATION TECHNIQUES

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation

PART – A

S.No	Questions	BT Level	Competence
1.	Assess the merits of X-Ray diffraction technique.	BTL 5	Evaluate
2.	What do you mean by primary, secondary, backscattered electrons in relation with SEM?	BTL 3	Apply
3.	What is the principle of SEM?	BTL 1	Remember
4.	Evaluate magnifying power.	BTL 5	Evaluate
5.	Mention the application of atomic force microscope.	BTL 4	Analyze
6.	What is x-ray diffraction?	BTL 1	Remember
7.	List the modes of SPM.	BTL 1	Remember
8.	Which mode of AFM is preferred to characterize delicate Nano surfaces? Why?	BTL 4	Analyze
9.	Differentiate SEM from TEM.	BTL 2	Understand
10.	Write the principle of Scanning Tunneling Microscopy.	BTL 2	Understand
11.	Write the principle of Scanning Probe Microscopy.	BTL 2	Understand
12.	Illustrate the importance of high resolution imaging in nanomaterial characterization.	BTL 3	Apply
13.	What do you mean by elastic and inelastic scattering of electrons?	BTL 4	Analyze
14.	List the applications of SNOM.	BTL 1	Remember
15.	What is the difference between STM and AFM?	BTL 2	Understand
16.	Draw the schematic diagram of SIM instrumentation.	BTL 6	Create
17.	Illustrate the use of Electron Microscopy.	BTL 3	Apply

18.	Define the term 'Nanoindentation'.	BTL 1	Remember
19.	Define the term SNOM and also list their modes.	BTL 1	Remember
20.	Write the principle and application of ESCA.	BTL 6	Create
21.	What is Nano indentation?	BTL 2	Understand
22.	Draw the photo emission Spectra of ESCA.	BTL 3	Apply
23.	Mention the advantages of SEM.	BTL 4	Analyze
24.	Write the formula for magnifying power.	BTL 5	Evaluate
PART B			
1.	Explain the working of Scanning Electron Microscopy (SEM) with a neat sketch. (13)	BTL 4	Analyze
2.	How do you characterize a material with Transmission Electron Microscope (TEM) with a neat sketch? (13)	BTL 6	Create
3.	Discuss in detail the principle and working of SEM with a neat sketch. (13)	BTL 2	Understand
4.	Explain the working of Scanning Tunnelling Microscopy with a neat sketch. (13)	BTL 4	Analyze
5.	Examine TEM including high resolution imaging. (13)	BTL 3	Apply
6.	Explain the principle, working and application of XRD with a neat diagram. (13)	BTL 4	Analyze
7.	(i) Compare and contrast AFM and SPM . (10) (ii) Predict the environmental techniques for nano material characterization. (3)	BTL 2	Understand
8.	Explain the working of ESCA with neat sketch. (13)	BTL 1	Remember
9.	Discuss the principle, working and applications of nanoindentation with a neat diagram. (13)	BTL 1	Remember
10.	Explain the working of SIMS with neat sketch. (13)	BTL 2	Understand
11.	Describe the principle and working of AFM with a sketch. (13)	BTL 1	Remember
12.	Describe the construction and working of Scanning Probe Microscopy (SPM) with a neat sketch. (13)	BTL 1	Remember
13.	Demonstrate the operation of Nano indentation using AFM and enumerate its applications. (13)	BTL 3	Apply
14.	(i) Discuss the basic principle, instrumentation and working of SNOM. (10) (ii) Discriminate merits and demerits of SNOM from other techniques. (3)	BTL 5	Evaluate
15.	Brief about any two surface analysis technique. (13)	BTL 2	Understand
16.	Illustrate and explain about the structure of Typical powder Diffractometer. (13)	BTL 3	Apply
17.	Explain about the electron tunnelling phenomenon used for surface analysis. (13)	BTL 4	Analyze
PART C			
1.	Explain the same preparation and the use of TEM in the characterization of nanomaterials. (15)	BTL 5	Evaluate
2.	Explain high resolution of transmission electron microscopy with schematic diagram. (15)	BTL 5	Evaluate
3.	Explain an application which uses surface analysis techniques. (15)	BTL 6	Create
4.	Discuss the importance of electron microscopy in characterization of nano materials in brief. (15)	BTL 6	Create
5.	Brief about Nano indentation and explain its application in any one field. (15)		

UNIT V- APPLICATIONS

Nano InfoTech: Information storage- Nano computer, molecular switch, super chip, Nano crystal, Nano biotechnology: Nano probes in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bio imaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery

PART – A

S.No	Questions	BT Level	Competence
1.	How Nano science is used for information storage?	BTL 3	Apply
2.	What is Nano computer?	BTL 3	Apply
3.	Analyze the role of nanotechnology in targeted drug delivery.	BTL 4	Analyze
4.	What is super chip?	BTL 3	Apply
5.	Define nano crystal.	BTL 1	Remember
6.	Analyze the role of nanoparticles in bio imaging.	BTL 4	Analyze
7.	Summarize the advantages of nanoprobe in medical field.	BTL 6	Create
8.	What do you mean by targeted drug delivery?	BTL 3	Apply
9.	Define NEMS.	BTL 1	Remember
10.	Differentiate between MEMS and NEMS.	BTL 4	Analyze
11.	How Nano silver inhibits the bacterial action?	BTL 5	Evaluate
12.	List nano based drug delivery vehicles.	BTL 1	Remember
13.	List the applications of NEMS.	BTL 1	Remember
14.	What is the role of Nano science in Solar cell?	BTL 1	Remember
15.	Write the fabrication methods of MEMS.	BTL 6	Create
16.	Give any two applications of solar cell.	BTL 2	Understand
17.	What is solar cell?	BTL 1	Remember
18.	Compare molecular crystal memory and molecular switch.	BTL 2	Understand
19.	Define Nano computers.	BTL 2	Understand
20.	What are nanosensors? Give example.	BTL 2	Understand
21.	Write the principle of solar cell.	BTL 2	Understand
22.	Mentions the applications of nano probe.	BTL 3	Apply
23.	Summarize the need for data storage device.	BTL 4	Analyze
24.	Write about molecular switch.	BTL 5	Evaluate

PART B

1.	What is Nano InfoTech and explain in brief with neat sketch. (13)	BTL 2	Understand
2.	Explain the following terms with neat sketch: (i) Nano crystal memory (7) (ii) Molecular switch (6)	BTL 3	Apply
3.	Give detail about Bio imaging using nano particles with neat sketch. (13)	BTL 6	Create
4.	Discuss various applications of nanosensors in biotechnology. (13)	BTL 1	Remember
5.	Explain the role of nanoparticles in medical field. (13)	BTL 3	Apply
6.	Discuss the role of nanotechnology in the fabrication of sun barrier products and antibacterial products. (13)	BTL 4	Analyze
7.	Discuss in detail about MEMS and NEMS and compare it. (13)	BTL 2	Understand

8.	Explain about the term (i) Nano computer. (7) (ii) Superchip. (6)	BTL 4	Analyze
9.	Explain the significance of nanobiotechnology? Discuss briefly the use of nanoprobes in medical diagnostics. (13)	BTL 1	Remember
10.	Explain Nano science in (i)Photostat. (7) (ii)Printing. (6)	BTL 4	Analyze
11.	(i) How information is stored using Nano techniques. (10) (ii)Why Nanoparticles are selected for Nano medicines.(3)	BTL 3	Apply
12.	Explain the designing and uses of nanosensors with suitable examples. (13)	BTL 1	Remember
13.	Discuss the application of nano technology in the field of Solar cells. (13)	BTL 5	Evaluate
14.	Explain targeted drug delivery with neat sketch. (13)	BTL 2	Understand
15.	Brief about the Nano medicines and Targeted drug delivery. (13)	BTL 2	Understand
16.	Discuss the use of nanoprobes in diagnostic of cancer. (13)	BTL 3	Apply
17.	Elaborate the significance of MEMS with any applications. (13)	BTL 4	Analyze
PART C			
1.	Give the role of Nano probes in Nano biotechnology. (15)	BTL 6	Create
2.	Explain how Nano silver crystalline used for Bacterial inhibition. (15)	BTL 6	Create
3.	Discuss the recent developments in the usage of quantum dots in drug delivery and sensor applications. (15)	BTL 6	Create
4.	Discuss the applications of nano technology in the field of Sensor. (15)	BTL 6	Create
5.	Discuss the application of Micro Electro Mechanical Systems (MEMS) of your choice. (15)	BTL 6	Create