Karunya University
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End Semester Examinations - Nov-Dec 2015 Exams

14NT2001 Fundamentals of Nanotechnology

Set B

Time : 3 hrs
Total Marks: 100

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1. 1a).Explain in detail about the various scientist involved in evolution of nanotechnology (15 marks)

   b). Name any 5 characterization techniques used to measure the properties of nanoparticles(5 marks)

OR

2. 2a).Explain in detail about quantum confinement with examples (15 marks)

   b). Give few examples for natural and manmade nanomaterials (5 marks

3. 3).Write in detail, how CNT is used in the following applications

   a. Transistor (4 marks)

   b. Nanopores (4 marks)

   c. H2 Storage (4 marks)

   d. Flow sensor (4 marks)

   e. Nanotube filter (4 marks)

OR

4. 4).Discuss the electrical, mechanical, physical and transportation properties of CNT in detail (20 marks)

5. 5a). Explain in detail the various criteria of Clean room (15 marks)

   b) Difference between simple and compound microscope (5 marks)

OR

6. 6.a).Applications of TEM (2 marks)

   b) What are pros and cons of Tem (2 marks)

   c).What are the basic systems used for making up a TEM (10 marks)

   d).Draw the schematic diagram of TEM and explain the various components in it (6 marks)

7. 7a). Write a note on various properties of graphene (10 marks)

   b). Discuss the various ways in which cancer can be detected and diagnosed using nanotechnology (10 marks)

OR

8. 8 a).Draw the schematic diagram of SEM and explain the various components (10 marks)

   b).What are various signals emitted from the sample in SEM (5 marks)

   c).Difference between SEM and TEM (5 marks)

9. 9a).With a neat diagram explain the working principle of STM (10 marks)

   b). Advantages and disadvantages of STM (5 marks)

   c).Different imaging modes in STM (2 marks)

   d).Application of STM (3 marks)

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End Semester Examinations - Nov-Dec 2015 Exams

14NT2002 Materials Science and Engineering – I

Set B

Time : 3 hrs
Total Marks: 100

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1. a) Sketch the (100), (110) and (111) planes of a simple cubic structure. (2)

   b) How Miller indices are determined? Explain. (2)

   c) What are Miller indices? Sketch two successive (110) planes. Show that for a cubic lattice the distance between two successive plane (hkl) is given by $d = a / \sqrt{(h^2+k^2+l^2)}$.(12)

   d) The distance between (110) plane in a BCC structure is 2.07Å. What is the size of unit cell? (4)

OR

2. a) The diffraction pattern of copper metal was measured with X-ray radiation of wavelength of 1.315Å. The first order Bragg diffraction peak was found at an angle of 50.5°. Calculate the d-spacing between the diffracting planes in the copper metal. (3)

   b) With neat diagram explain about Bragg's law and its derivation. (10)

   c) What is the distance between the adjacent Miller planes if the first order reflection from X-rays of wavelength 2.29Å occurs at $27^o8'$? (5)

   d) What is point defect? (2)

3. a) Define p-type and n-type semiconductor. (2)

   b) Write short notes on Fermi level. (2)

   c) Discuss about point defects and imperfections. (8)

   d) Explain with neat sketch the intrinsic and extrinsic semiconducting materials. (8)

OR

4. a) Distinguish between a dielectric material and an insulator with suitable diagram. (4)

   b) What is meant by polarisation? Derive equations for electric flux density and with suitable diagram explain electronic polarisation and deduce an expression for electronic polarisability.(12)

   d) Calculate the electronic polarizability of an isolated Se atom. The atomic radius of Se atoms is 0.12 nm. (2)

   e) What is an electric dipole? Briefly explain. (2)

5. a) Is Silicon an intrinsic or extrinsic semiconductor? Explain the effect of doping in Silicon with suitable sketch. (15)

   b) Calculate the wavelength of light emitted by an LED with band gap of energy 1.4 eV (2)

   c) What is ionic polarization. (3)

OR

6. a) Define Hall Effect. Explain in detail the use of Hall Effect measurement.(15)

   b) Differentiate metals, semiconductors and insulators based on their band gap. (5)

7. a) Define polarisation. With suitable diagram explain the two different types of polarisations: Electronic and Ionic polarisation. (12)

b) A parallel plate capacitor consists of 2 plates each of area 4×10^{-4} m^2. They are separated by a distance of 1.5×10^{-3} m and filled with a dielectric of relative permittivity 6. Calculate the charge on the capacitor if it is connected to a 100 volts d.c. supply.(2)

c) Write notes on the following.

i) intrinsic semiconductor ii) extrinsic semiconductor (6)

OR

8. a) What is meant by local field in a solid dielectric. Derive the Clausius-Mosotti relation for the local field in a solid dielectric. (10)

b) Define electric flux density. (2)

c) State dielectric constant. (2)

d) With a neat sketch differentiate p-type and n-type semiconductors. Give examples.(6)

9. a) Discuss the applications of diffusion in sintering. (6)

b) Define Fick's law of diffusion and discuss the factors that influence the diffusion. (6)

c) Write short notes on the surface hardening of metals. (4)

d) Briefly discuss the doping of semiconductors. (4)

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End Semester Examinations - Nov-Dec 2015 Exams

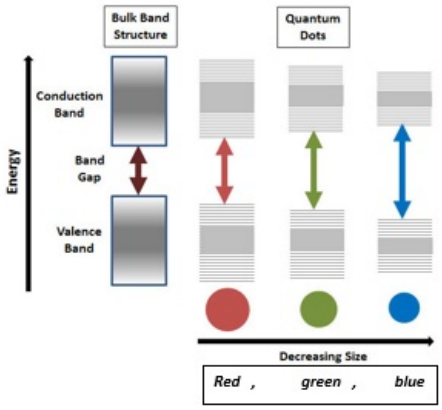
14NT2003 Applications of Nanotechnology

Set B

Time : 3 hrs
Total Marks: 100

1. a) What will happen when there is an increase in surface to volume ratio? (3)

   b) Explain what you understand from the following figure. (3)



   c) Explain in detail any 4 applications of nanotechnology in everyday life. Give the examples of medical devices utilizing nanotechnology. (12+2)

OR

2. a) If you have a cube of pure gold and cut it, what color would the pieces be? If you keep on cutting each block in half - will the pieces of gold always look "gold"? What happens and why does it happen? (3)

   b) What are the two principal factors that cause the properties of Nano Materials to differ significantly from other materials? (3)

   c) Briefly explain the applications of nanotechnology in the following areas i) construction ii) Data storage iii) Defense iv) Electronics v) Energy vi) Agriculture vii) Medical devices. (14)

3. a) Find the surface to volume ratio of a 1m cube. (3)

   b) Define nanoscience and nanotechnology. (3)

   c) With a neat sketch explain 0D, 1D, 2D and 3D structures. (10)

   d) Differentiate the bulk energy gap from that of quantum dots. (4)

OR

4. a) Differentiate 1D, 2D and 3D quantum confinement effect. Give examples. (3)

   b) Write short notes on super hardness. (3)

   c) Briefly discuss the role of nanotechnology in electronics. (2)

   d) Briefly explain the applications of nanotechnology based on the following properties i) antimicrobial ii) photocatalytic iii) antireflection iv) odour resistance (12)

5. a) Mention the reason for increase in yield strength in nanomaterials.(3)

   b) Justify why nanomaterial is in the quantum confinement regime. (3)

   c) What do you mean by exciton Bohr radius? (2)

d) Explain in detail, the chemical properties of nanomaterials based on reactivity, solubility and melting point. (12)

OR

6. a) List the major optoelectronic devices. (3)

b) Briefly explain the effect of high carrier injection in semiconductors. (3)

c) Discuss in detail, the role of nanotechnology in the improvement of computer memory. (14)

7. a) With suitable sketch, explain the basic principle and differentiate the working of Laser diodes and LEDs.(16)

b) Mention the trends in opto-electronic devices. (4)

OR

8. a) Write short notes on nanowire race tracks. (3)

b) Briefly explain the application of nanotechnology in automobile sector. (3)

c) Discuss in detail, the optical properties of nanomaterials. (14)

9. What is the need for new drug delivery systems? Explain in detail, the various types of drug delivery. (20)

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End Semester Examinations - Nov-Dec 2015 Exams

14NT2008 Materials Science and Engineering - II

Set B

Time : 3 hrs
Total Marks: 100

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1. a) Briefly explain what are elastomers? (3)

   b) Which type of powder pressing procedures need not be followed by a firing process? Why?(3)

   c) What are the different metal fabrication techniques? With suitable sketch explain in detail the different forming operations used in metal fabrication. (14)

OR

2. a) Is powder metallurgy process suitable for metals having low ductility? If yes, why? (3)

   b) Briefly explain why glass–ceramics may not be transparent. (3)

   c) Mention the classification of polymeric materials. Discuss in detail the mechanical behavior of polymers with suitable stress-strain diagram. (14)

3. a) Define polydispersity index. (3)

   b) Is it possible to control the thermal shock in materials? How? (3)

   c) List the different molding techniques employed to mold polymers. Briefly expalin any two molding techniques. (6)

   d) Mention the classification of composites. Discuss the particulate composites in detail. (8)

OR

4. a) Define the term “degree of Polymerization”. (3)

   d) What is a composite? What is the role of reinforcement and matrix in glass fiber reinforced polymer matrix composite? (4)

   c) Explain in detail the different types of polymer synthesis. Give examples. (10)

   d) A continuous and aligned glass fiber-reinforced composite consists of 30 vol% of glass fibers having a modulus of elasticity of 69 GPA and 70% of a polyester resin, that when hardened, displays a modulus of 2.5 GPA. Compute the modulus of elasticity of this composite in the longitudinal direction. (3)

5. a) Explain the reason for increase in thermal conductivity of ceramics at very high temperature. (2)

   b) What is the origin of thermal expansion in solids? (3)

   c) Differentiate number average molecular weight and weight average molecular weight. How are they useful in determination of the degree of polymerization (7)

   d) A continuous and aligned glass fiber-reinforced composite consists of 40 vol% of glass fibers having a modulus of elasticity of 69 GPA and 60% of a polyester resin, that when hardened, displays a modulus of 3.4 GPA. If the cross sectional area is 250 mm^2 and a stress of 50 Mpa is applied in the longitudinal direction, find out which phase supports the vast majority of load. (8)

OR

6. a) What is the origin of thermal expansion in solids? (3)

   b) Define heat capacity of a material. (2)

c) With a suitable diagram, explain in detail, the polymer forming mechanics. (8)

d) Discuss in detail, the different types of fiber reinforced composites. (7)

7. a) Discuss in details, the types of semiconductors with suitable diagram and give examples.(10)

b) Briefly discuss the electrical conduction in ionic ceramics. (3)

c) Differentiate active and passive dielectrics. (4)

d) Define anti-ferro magnetism. Mention its characteristics. Give examples. (3)

OR

8. a) Why do metals have high conductivity? (2)

b) Briefly discuss the Mathiessens rule of resistivity.(3)

c) Define ferri magnetism. Mention its characteristics. Give examples. (3)

d) What are ferromagnetic materials? Explain in detail, the Hysteresis curve for ferromagnetic materials. (12)

9. a) Explain in the detail, the four different optical phenomena of non-metallic materials. (15)

b) Differentiate transparent, translucent and opaque materials. (5)

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End Semester Examinations - Nov-Dec 2015 Exams

14NT3005 Nanotechnology for Drug Delivery System

Set A

Time : 3 hrs
Total Marks: 100

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1. 1. Explain in detail ADME Hypothesis and state its importance (20)

OR

2. 2. Explain on the different modes of drug delivery (20)

3. 3. Give an expert opinion on nanoparticles for cancer therapy (20)

OR

4. 4. (a) Discuss the organ kidney with a neat diagram (10)

(b) Give an account on glomerular filteration with a neat diagram (10)

5. 5. Highlight on the general overview of using nanoparticles for targetted drug delivery (20)

OR

6. 6. List any ten applications of nanotechnology in drug delivery (20)

7. 7. (a) Draw a neat sketch of an animal cell and explain its parts (10)

(b) What is surface modification and its advantages (10)

OR

8. 8. Discuss a general overview of surface modified nanoparticles (20)

9. 9. Detail on surface modification of magnetite iron oxide nanoparticles (20)

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14NT3009 Nanoscale Transistors

Set B

Time : 3 hrs
Total Marks: 100

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1. a. Explain about Density of State with required equations and diagrams. (8)

   b. Discuss in detail about modeling of MOSFET current voltage (I-V) characteristics in related with related with resistor and current source characteristics curves. (12)

OR

2. a. Discuss about Ballistic and Diffusion transport of electron in a channel with neat diagram. (5)

   b. Explain about MOSFET Scaling and discuss about various scaling methods used for MOSFET. (15)

3. a. Discuss about Silicon-On-Insulator in detail with neat diagram (7)

   b. Brief about the Depletion SOI MOS transistor with neat diagram. (7)

   c. Discuss about miniaturization with SOI in with neat diagram. (6)

OR

4. a. Brief about the short channel MOSFET. (3)

   b. Explain about drain induced barrier lowering (DIBL) with band structure of MOS transistor. (10)

   c. Discuss about various Multi gate transistor. (7)

5. a. Explain about the fabrication concept of Fully Silicided Metal Gate (FUSI) with neat diagram. (12)

   b. Explain in detail about Gate patterning of Multi gate MOSFET with neat diagram. (8)

OR

6. a. Explain in detail about fabrication sequence of a Tri-gate MOSFET with neat diagram. (10)

   b. Discuss about the Four Terminal-MuGFET fabrication and working principle of independently controlled gate with its I-V characteristics. (10)

7. a. Discuss in detail about Mobility and Strain Engineering of Fin FET with neat diagram. (14)

   b. Explain about the less than of 45 degree angle method of fabrication of Source and Drain with neat diagram. (6)

OR

8. a. How to reduce the parasitic resistance in Fin FET with Source and Drain Structure. (8)

   b. Explain in detail about the various contacts to the Fin FET with neat diagram. (12)

9. Explain in detail about the various materials used in Nanoscale Gate All Around transistor and also discuss its electrical characteristics with diagram. (20)

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End Semester Examinations - Nov-Dec 2015 Exams

14NT3013 Solar Energy: Advanced Materials and Devices

Set A

Time : 3 hrs
Total Marks: 100

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1. a.Explain the Construction of a simple PN junction solar cell (5 marks)

   b. Demonstrate the working of Silicon PN junction solar cell with itsV-I characteristics (10 Marks)

   c.Define exciton and differentiate it from the free electron (5 Marks)

OR

2. a.Recall about the solar cell parameters with suitable equations (10 marks)

   b.Classify the Family of Photovoltaics cells based on the materials and stuctures (10 marks)

3. a. Illustrate the conditions for achieving improved efficiency in a solar cell (10 marks)

   b. Classify the physical and chemical methods of preparation of thin films for solar cell fabrications (10 marks)

OR

4. a. Illustrate the optical absorption of materials and the wave length response of different materials 10 marks)

   b. what are cascade solar cells? with suitable diagrams explain the salient features of it (10 marks)

5. a.Explain the concept of Drift current (5 marks)

   b. Derive the carrier transport in semiconductors by solving the drift current equation (15) Marks)

OR

6. a.Define Diffusion current and write equation for hole and electron diffusion currents.(5 marks)

   b.An n type silicon sample has a donor concentration of $1x\ 10^{17}\ cm^{-3}$.P0 $=2.25\ x10^{3}$ cm-3 and Ec-Ef=1.5 eV.by illumination the sample we introduce Gop$=5x10^{20}\ cm^{-3}$. Assume carrier life time of $2x10^{-6}$. Calculate the resulting electron hole concentration. And also calculate the quasi fermi energy levels.Explain how the energy bands will tilt due to doping gradient with suitable equations.
   (15 marks)

7. a. Illustrate the conditions for achieving quasi fermi energies (10 marks)

   b. Derive the Einstein relation for carrier diffusion (10 marks)

OR

8. a. Explain the diffusion mechanism in a solid semiconductor rod and derive the diffusion equation for holes and electrons (20 marks)

9. a. With suitable diagrams explain the working of the DSSC solar cells (10 marks)

   b. Explain the concept of the Homo-Lumo in the DSSC solar cells (10 marks)

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End Semester Examinations - Nov-Dec 2015 Exams

14NT3021 Semiconductor Nanostructures & Nanoparticles

Set B

Time : 3 hrs
Total Marks: 100

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1. Explain various types of optical behaviour of material and its equation in detail with an example.(20 Marks)

OR

2. Write the importance of electrical properties in nano particle and explain the various electrical properties in detail.(20 Marks)

3. a. Write down the importance of synthesis in nano materials and explain nano material synthesis using CVD method in detail.(10 marks)

   b. Discuss top down, intermediate and bottom up approach of nano material synthesis in detail with relevant diagrams.(10 marks)

OR

4. Discuss various types of 0-D and 1-D types of nano material synthesis and its importance in detail.(20 Marks)

5. Explain various types of mechanical properties in nanowire and its importance in detail.(20 Marks)

OR

6. Write the importance of Ultra capacitor and its operation related to Nanotechnology applications.(20 Marks)

7. What is mean by solar cell ? Discuss the operation of conventional solar cell using its electrical parameters in detail. (20 Marks)

OR

8. a.Write various types of applications based on LED in nano systems? (10marks)

   b.Draw the structure of LED and explain its operation in detail? (10marks)

9. a. Explain the growth of silicon nanowire by VLS mechanism with schematic diagram.(10 marks)

   b. Discuss different types of nanowire characterization technique in detail with detailed diagram.(10 marks)

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End Semester Examinations - Nov-Dec 2015 Exams

14NT3023 MEMS and Nanotechnology

Set A **Time : 3 hrs**
Total Marks: 100

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1. a. Explain about the Planar fabrication techniques of MEMS with necessary diagram. (14)

   b. Explain about the Design and Modeling of MEMS. (6)

OR

2. a. Explain about the MEMS packing in detail. (15)

   b. Explain about the MEMS pressure sensor with neat diagram. (5)

3. Explain in detail about the various CMOS-MEMS micromachining methods with neat diagram. (20)

OR

4. Briefly explain about the Non-Slicon based Liquid Crystal Polymer (LCP) for MEMS fabrications with neat diagram. (15)

5. Describe about the Fabrication Processes for Poly dimethyl siloxane (PDMS) with neat diagram. (20)

OR

6. a. Explain in detail about Printed Circuit board based MEMS technologies with various steps to carry out the fabrication of the device. (15)

   b. Brief about the benefits of Non-Silicon MEMS over the Silicon MEMS technology. (5)

7. a. Brief about PZT- Based Piezoelectric MEMS Technology with neat diagram. (12)

   b. Describe in detail about MEMS based digital gates with neat diagram (8)

OR

8. Explain about MEMS based memory device and also discuss in detail about Probe Tip Fabrication used in storage devices. (20)

9. a. Briefly explain about various property analysis of fabricated MEMS/NEMS with neat diagram. (12)

   b. Describe about various tools used for analysis of MEMS/NEMS devices in detail. (8)

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