

# BITS PILANI DUBAI CAMPUS

## FIRST SEMESTER 2011-12

### Comprehensive Examination (Closed Book)

Course No: EA C416

Duration: 3Hrs

Weightage: 40%

Course Name: Introduction to Nanoscience

Max Marks: 40

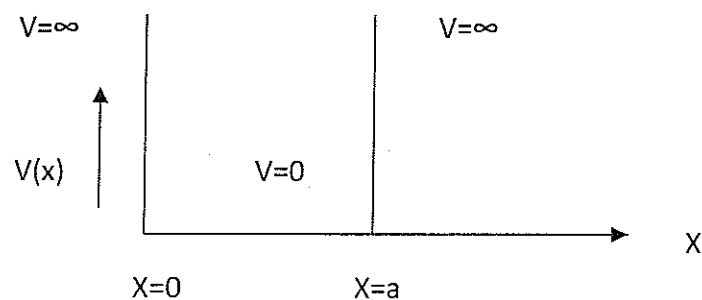
Date: 11.1.2012

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- Q1. (a) Calculate the lattice constant for a rock salt crystal ( $\rho = 2.18\text{g/cm}^3$ ). Given that crystal has fcc lattice and molecular weight =58.8 (3)
- (b) Calculate the glancing angle on the cube (1 0 0) of a rock salt crystal ( $a = 2.814\text{\AA}$ ) corresponding to second order diffraction maximum for X- rays of wavelength  $0.71\text{\AA}$ . (3)
- Q2. (a) Explain the working operation with proper diagrams of the scanning electron microscope which is used for the characterization of the nano materials (2)
- (b) Mention any three techniques and their analytical value for each one of the following:
- (1) Electron probe characterization methods
  - (2) Scanning probe characterization methods
  - (3) Photon probe characterization methods
  - (4) Ion probe characterization methods (4)
- Q3. (a) Discuss in detail the operation ( with diagram) of molecular beam epitaxy method for fabrication of nano material. (4)
- (b) In a chemical vapor deposition method for fabrication of nanomaterial describe about
- (i) carbon source used ,(ii) catalyst (iii) operating conditions (iv) range of temperature for SWNT and MWNT (2)
- Q4.(a) Given chiral vector  $C = na_1 + ma_2$ , (where n and m are integers ). Consider a carbon nano tube having (n,m) ::(4,1). Calculate the chiral angle  $\Theta$  for this tube. (2)
- (b) Calculate the diameter of the SWNT having (n m) as (6 6). The C-C bond length is 0.142nm. (2)

- Q5 (a) Describe the principle of operation of an accelerometer. (2)
- (b) Mention the name of any 4 acceleration sensors. (1)
- (c) Mention the name of any 4 pressure nanosensors. (1)
- (d) Why nano sensors are better than any other microsensors (2)

- Q6. (a) Give the definition of quantum well, quantum wire and quantum dot. Give the approximate size of each one of them. (2)
- (b) Describe in detail any method of preparation of Quantum dot structure. (3)

- Q7. Consider a particle of mass  $m$  in a box with impenetrable walls (infinite potential well) as shown in figure below: Starting from Schrödinger equation derive the expression for the wave function, calculate the normalization constant and calculate the values of  $x$  for which probability will be maximum. (4)



- Q8.(a) Mention the size of the following biological nano material: Amino acids , Nucleotide , Protein and Influenza virus (1)
- (b) What is transcription and what is the role t-RNA in protein synthesis (1)
- (c) Mention the sequence of start codon any two stop codons (1)

-----best of luck-----

**BITS PILANI DUBAI CAMPUS  
FIRST SEMESTER 2011-12**

**Test-2 (Open Book)**

**Course No: EA C416**

**Duration: 50 Mints**

**Weightage: 20%**

**Course Name: Introduction to Nanoscience**

**Max Marks:20**

**Date: 18.12.11**

**Note: All the questions are compulsory.**

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**Q1 (A)** Describe the experimental technique for synthesis of Fullerene in a lab. (3)

**(B)** Describe important steps involved in fabrication of carbon nano tube using laser evaporation technique. (3)

**Q2(A)** Explain about different types of carbon nano tubes with the help of diagrams.(2)

**(B)** Given chiral vector  $C = na_1 + ma_2$ , (where n and m are integers ) and  $\Theta$  is the chiral angle. What is the relationship between(n,m) and  $\Theta$ . What are the values of  $\Theta$  for zigzag and armchair carbon nanotubes? (2)

**Q3 (A)**For the following combination of (n,m), predict the type of CNT (e.g. chiral, zigzag or armchair): (A) (3,3) (B) (15,0) (C) (15,12) (D) (12,9) (2)

**(B)** For the following combination of (n,m), predict the nature of CNT (e.g. conducting or semiconducting) (A) (5,0) (B) (6,0) (C) (6,1) (D) (6,3) (2)

**Q4 (A)** What are the different components of a Nanobiosensor?

**(B)** Mention at least three important application of Nanobiosensor?

**(C)** How Nanobiosensor is used for cancer monitoring? (2+2+2)

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Goodluck

**BITS PILANI DUBAI CAMPUS  
FIRST SEMESTER 2011-12**

Course No: EA C416

Duration: 50 Mints

Weightage: 20%

Test-1(Closed Book)

Course Name: Introduction to Nanoscience

Max Marks:20

Date: 23.10.2011

**Note:** All the questions are compulsory.

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Q 1. The orthorhombic nanocrystal has axial units in the ratio of 0.424 : 1 : 0.367. Find the Miller indices of a nanocrystal face whose intercepts are in the ratio 0.212 : 1 : 0.183.

(4)

Q 2. A nanomaterial with f.c.c. lattice has density  $6250 \text{ kg/ m}^3$  and molecular weight 60.2. Calculate the lattice constant . Given Avogadro Number  $6.02 \times 10^{26} \text{ kg/mole}$

(4)

Q. 3. The Braggs angle corresponding to the first order reflection from (1 1 1) planes in a nanocrystal is  $30^\circ$  when X-rays of wavelength  $1.75 \text{ \AA}$  are used. Calculate the interatomic spacing.

(4)

Q 4. (A) Mention any four processes involved in Top down approach for fabrication of nanomaterial.

(1)

(B) Mention any four processes involved in Bottom up approach for fabrication of nanomaterial.

(1)

( C) Discuss in detail about the Lithography technique for fabrication of nanomaterial. (2)

Q5. (A) In electron microscopy for characterization of nanomaterial , mention all the possible processes involved when electron interacts with material. (2)

(B) In an electron microscope an electron falls from rest through a potential difference of 100V. What is its de Broglie wavelength. (2)

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Good luck

BITS PILANI DUBAI CAMPUS

FIRST SEMESTER 2011-12

Quiz(Closed Book)

Course Name: Introduction to Nanoscience

Course No: EA C416

Time: 20 Mints

Max Marks: 14(7x2)

Weightage:5%

Date: 26.9.2011

Name:

Id No

Q1.	Give the definition of primitive and non primitive cell .
Ans	
Q2.	Out of the following which are primitive and which are non primitive cell 1. Cubic unit cell 1. Face centered cubic 3. Body centered cubic
Ans	
Q3	Mention the name of five Bravais lattices in 2-D
Ans	
Q4	If a particular plane has the intercepts 2,3 and $\infty$ along a,b and c axes, what are the Miller indices of this plane.
Ans	
Q5	Draw the planes for the following Miller Indices 1. [1 10] 2. [1 1 1] 3. [1 0 0]
Ans	
Q6	The lattice constant of a cubic lattice is a. Calculate the spacing between [112] planes.
Ans	
Q7	A neutron beam is falling on a crystal . Given $\Theta=30^\circ$ , $d=3.84\text{\AA}$ , $n=1$ . Calculate the wavelength of the neutron beam and the speed of neutrons.
Ans	