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63/2 (SEM-1) PHY 106 (OE)

2021

(held in 2022)

**PHYSICS**

(Theory Paper)

Paper Code : PHY-106 OE)

(Nanostructures)

Full Marks – 50

Time – Two hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 1×5=5
  - (a) Why is thin film technology important ? 1
  - (b) Why vacuum is important in evaporation technique ? 1
  - (c) What are the parameters that affect the size of the nanomaterial in ball milling process ? 1
  - (d) What are microporous and macroporous materials ? 1
  - (e) Write Scherrer's formula for estimation of crystallite size. 1

[Turn over

2. Answer the following questions :  $2 \times 5 = 10$

(a) What are top-down and bottom-up approaches for the preparation of nanomaterials ? Mention at least two techniques for both the approach.

2

(b) Explain how the grain size can be controlled in electron beam evaporation technique.

2

(c) What is the significance of soft backing in photolithography ?

2

(d) How many pentagons or hexagon structures are there in fullerene ? Mention two properties of  $C_{60}$  molecule.

1+1=2

(e) What is dislocation density in crystalline solids ? Give Williamson and Smallman's formula for estimation of dislocation density.

2

3. Answer any seven of the following :  $5 \times 7 = 35$

(a) Write down the working principle of thermal evaporation method for deposition of thin film with proper diagram. Mention its advantages and disadvantages.

3+2=5

(b) Explain the photolithography process. Write at least four major limitations of photolithography.

3+2=5

(c) Discuss the hydrothermal method for synthesis of nanomaterial. Write its advantages and disadvantages.

3+2=5

(d) What are different types of core shell ? Explain in details.

5

(e) Write notes on zeolites materials. Give some applications of zeolite materials.

3+2=5

(f) What are Carbon Nanotubes ? Explain their properties.

1+4=5

(g) What are quantum wire and quantum dot ? Write notes on quantum confinement effect.

2+3=5