Ex/PG/NANO/T/116A/198/2014

& MET-IM-MATE/T/116A/167/2014

**MASTER OF TECH. MATTERIAL ENGINEERING EXAMINATION, 2014**

**MASTER OF METALLURGICAL ENGINEERING (IM) EXAMINATION, 2014**

**MASTER OF TECHNOLOGY IN NANO SCIENCE & TECHNOLOGY EXAMINATION, 2014**

( 1st Semester )

**SYNTHESIS OF NANOMATERIALS**

Time : Three hours Full Marks : 100

Use a separate Answer-Script for each part

**PART - I (6O Marks)**

Attempt ***any three*** questions.

1. a) Materials in nanoscale exhibit physical properties distinctly different from bulk. Justify the above statement with example. 8

   b) How will you group the Nanostructure Materials on the basis of growth media ? Illustrate. 7

   c) Compare the behavior of Nanostructure of bottom up approach with respect to top down approach. 5

2. a) Define surface energy. Is there any effect on the lattice constant on low dimension material ? 5

b) Differentiate between Sintering with Ostwald ripening. 5

c) How the surface geometry of particle affect chemical potential ? Explain. 10

3. a) Explain the techniques of stabilization of high energy nanostructure materials. 10

b) Explain the principle of Planetary Mill. Compare the variation in product nature by different milling techniques. 10

4. a) What is the role of substrate in evaporation technique ? Suggest process parameters for efficient deposition. 10

b) Explain the principle of dc sputtering with a neat sketch. How does the RF sputtering differ from dc sputtering ? 10

5. a) Explain the principle of low pressure CVD technique. 10

b) How can you optimize the gas transport parameters for efficient CVD ? Explain. 10



**PART - II (40 marks)**

Attempt ***any two*** questions.

6. a) Explain the steps of synthesis of nanomaterials by spray pyrolysis process. 10

b) Discuss the effects of the solubility of the solute in the solvent, diffusivity of the solvent vapour through the precipitated layer and the thermal conductivity of the precipitated layer on the spray pyrolysis process. 10

7. a) What are the different approaches of photolithography ? Explain the steps of shadow printing with a schematic diagram. 2+8

b) What is theoritical resolution capability in shadow printing ? Discuss the factors that affects the resolution. 2+5

c) Highlight the principle of projection printing. 3

8. a) What are the applications of ion exchange technique ? Explain the basic principle of this technique. 2+8

b) Discuss the main steps of sol-gel process. Explain how acid catalyst helps to increase the rate the hydrolysis in sol-gel process. 4+6