BBD-003-0491104 Seat No. _____

B. Sc. / M. Sc. (Applied Physics) (Sem. X) (CBCS) Examination

July - 2021

Paper-16 : Nanostructuring With Ion Beams

(Elective-4)

(New Course)

Faculty Code : 003

Subject Code : 0491104

Time : $2\frac{1}{2}$ Hours] [Total Marks : **70**

Instructions : Write any five questions.

1 Write answer of following short questions : (**Two** marks each) **14**

(1) Define a unit cell.

(2) What are projected range and straggling of energetic ions in a target?

(3) What is sputter erosion of materials by energetic ions?

(4) What is Ehrlich-Schwoebel barrier?

(5) Define parallel and perpendicular-mode ripple patterns.

(6) What happens to pattern formation when impurities are also incorporated onto the target surface during ion induced pattern fabrication?

(7) What happens to pattern formation when concurrent azimuthal rotation (beside tilt) is also provided onto the target surface during ion induced pattern fabrication?

2 Write answer of following short questions : (**Two** marks each) **14**

(1) How can the cold cathode electron emission performance be improved from nanofaceted Si surfaces?

(2) What is plasmonics? Give two examples where it can be applied efficiently.

(3) List the name of different regimes of ion induced pattern formation?

(4) What is meant by stopping cross-section?
(5) List various types of defects formed during ion interaction with solids?
(6) What is surface diffusion?
(7) List various applications of nanostructuring with ion beams.

3 Write answers of following questions. **14**

(1) Explain various crystal systems with necessary diagram in detail.
(2) State how many Bravais lattices are known to exist and explain in detail how the translational symmetry of the Bravais lattice are classified.

4 Write answers of following questions. **14**

(1) Draw schematic diagrams of Triclinic and Rhombohedral systems and show different angles as well as axes with their relationships. Give one each example of these two crystallographic systems.
(2) State the difference(s) between a direct and an indirect band-gap semiconductor along with schematic diagrams and two examples each.

5 Write answers of following questions. **14**

(1) Describe the advantages of ion-beam induced nano-patterning of materials and name all the parameters which can influence the pattern formation.
(2) Give a detail description (through a parametric phase diagram) of pattern formation on Si by energetic ($\leq$ 2 keV) inert gas ions (e.g. Ar-ions) by varying incident angle of ions.

6 Write answers of following questions. **14**

(1) What are the main competing processes during pattern formation? Explain it in terms of schematic diagrams.
(2) What is a morphologically anisotropic surface? Describe three examples where morphological anisotropy leads to anisotropic physical properties.

7 Write answers of following questions. **14**

(1) Draw a schematic diagram, showing all the processes involved in ion-beam induced fabrication of embedded nanoparticles in a thick substrate. You can start from t=0 and show the processes as a function of increasing time.

(2) Describe two methods and provide examples (one each) to fabricate highly ordered regular patterns (by energetic ion beams) on semiconductor surfaces.

8 Write answers of following questions. **14**

(1) Explain laser annealing with schematic diagram and its applications.

(2) Show a schematic diagram of cold cathode electron emission process and describe in detail how cold cathode electron emission takes place from a ion patterned nanofaceted Si surface.

9 Write answers of following questions. **14**

(1) Discuss the optical anisotropy in self aligned nanoparticles.

(2) Describe the applications of patterned oxide films in resistive switching.

10 Write answers of following questions. **14**

(1) Discuss Bradley-Harper (B-H) instability regime in pattern formation and surface evolution.

(2) Explain the phenomena of displacement cascades and generation of defects.
