## ELECTRON DIFFRACTION AND IMAGING

## Assignment -1 (Solution)

1. The border or fringe pattern is shown in the figure. Identify the motif around the lattice point in the given pattern and find out the symmetry element present in the motif.

a) Only 2 fold Rotation symmetry
b) 2 fold rotation plus two mirror symmetry with its reflection plane normal to rotation axes
c) $\mathbf{2}$ fold rotation plus two mirror symmetry with its reflection plane parallel to rotation axes
d) Only reflection symmetry $\perp$ to horizontal and vertical axes lying on the plane of paper

Answer: The motif of the given pattern is shown below,


The motif has 2-fold rotational symmetry and two mirror symmetry with its reflection plane parallel to rotational axis. Considering the plane of paper is $x-y$ plan, therefore the rotation axis is $z$ axis and the mirror planes are $x-z$ and $y-z$ plane.
2. The border or fringe pattern is shown in the figure. Identify the motif around the lattice point in the given pattern and find out the symmetry element present in the motif.

a) Translation and 2-fold rotation symmetry
b) Translation and reflection symmetry
c) Rotational and reflection symmetry
d) No symmetry

Answer: The motif of the given pattern is shown below,

3. A two dimensional square lattice having four fold rotational symmetry has been constructed by placing one layer of 1-D lattice upon another layer of 1- D lattice. The distance between two lattice points is A unit.

Layer: 2

Layer: 1


If every layer above the layer 1 is shifted by $A / 4$ unit then what is the symmetry of the new planar lattice?
a) Square lattice with two fold symmetry
b) Oblique lattice with two fold symmetry
c) Oblique lattice with four fold symmetry
d) Hexagonal lattice with six fold symmetry

Answer:


The new planer lattice will become oblique lattice because the four fold symmetry of the square lattice will be lost when the second layer will be shifted by A/4 unit. The new lattice will have only two fold symmetry
4. A quasicrystalline material will have
a) Translational and 5 fold rotational symmetry
b) Translational symmetry only
c) 5 fold rotational symmetry only
d) All the above
5. Choose the correct statements for stereographic projections.
a) Angular relations of poles on surface of sphere are represented in 2D.
b) Areal relations of 3D are represented in 2D.
c) Both angular and areal relations of 3D are represented in 2D.
d) None of the above.
6. If the diameter of the circle is 18 cm then what will be the linear distance from center N of Pole ' $R$ ' shown below on polar projection having coordinates $70^{\circ}$ on latitude on northern hemisphere and $60^{\circ}$ on longitude from East, $E$ ?


Answer: If $r$ is the radius of the primitive, latitude making an angle $\theta$ with north pole is represented by a circle around the centre with radius $\boldsymbol{r} \boldsymbol{\operatorname { t a n }}(\boldsymbol{\theta} / \mathbf{2})$

Here, $r=18 / 2=9 \mathrm{~cm}, \theta=70^{\circ}$
So, the distance, $d=9^{*} \tan \left(70^{\circ} / 2\right)=6.3 \mathrm{~cm}$.
7. [011] is zone axis for the following set of planes.
a) $(1-10)(-1-10)(0-11)$
b) $(-111)(-1-1-1)(1-11)$
c) $(1-11)(0-11)(-1-11)$
d) $(0-11)(10-1)(-1-10)$

Answer: Zone Weis law, h.u + k.v + I.w = 0
8. What is the angle between the pole ' $A$ ' and pole ' $B$ ' if the location of the poles on Wulff net is $\mathrm{A}\left(90^{\circ} \mathrm{E}, 35^{\circ} \mathrm{S}\right)$ and $\mathrm{B}\left(90^{\circ} \mathrm{W}, 35^{\circ} \mathrm{S}\right)$
(HINT: Do it manually on Wulff net and then measure it.)
a) $80^{\circ}$
b) $90^{\circ}$
c) $35^{\circ}$
d) $45^{\circ}$
9. Choose the correct statements for stereographic projections.
a) Equal angles are represented by equal distances on the primitive circle.
b) Equal angles are represented by equal distance on equatorial plane.
c) Equal angles are represented by equal distance on NS axis.
d) Any circle on the surface of a sphere is represented as ellipse on the stereogram.
10. What are the angular co-ordinates of the pole 'marked on the Wulff net?
a) $60^{\circ} \mathbf{E}, \mathbf{3 0 ^ { \circ }} \mathbf{N}$
b) $30^{\circ} \mathrm{E}, 60^{\circ} \mathrm{N}$
c) $0^{\circ} \mathrm{E}, 30^{\circ} \mathrm{N}$
d) $90^{\circ} \mathrm{E}, 60^{\circ} \mathrm{N}$


